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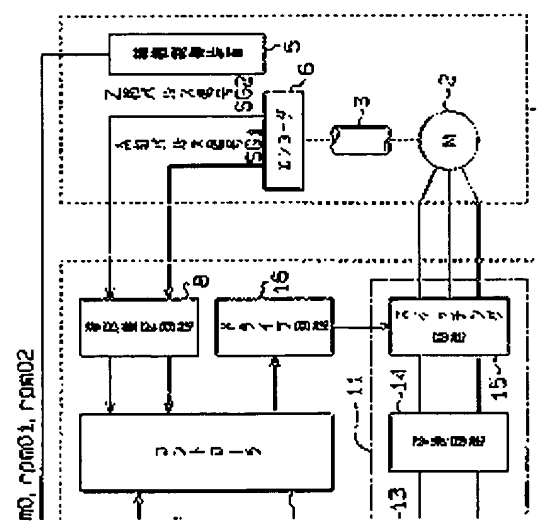
(54)【発明の名称】　織機の回転数制御装置及び回転数制御方法

(57)【要約】

【目的】織機又はモータが1回転するまでの間に織機又はモータの回転数を急激に変化させることを可能とする。

【構成】シャフト3が1回転する毎に出力されるZ相パルス信号SG2と、シャフト3が1回転する間に180個出力されるA相パルス信号SG1とに基づいてシャフト3が1回転する間のA相パルス信号SG1の周期に基づきそのときどきの瞬時回転数を求めた後、最小瞬時回転数から最大瞬時回転数へ移行する軽負荷移行領域、最大瞬時回転数から最小瞬時回転数へ移行する重負荷移行領域を求めるとともに、シャフト3の指令回転数を上昇させるとき、軽負荷移行領域内にてモータ2に出力される指令周



【特許請求の範囲】

【請求項１】　モータによって動作する織機の回転数制御装置において、

前記モータに出力される指令周波数を変化させることにより、該モータの回転数を制御して織機の回転数を制御するインバータ制御手段と、

前記織機又はモータが１回転する毎にパルス信号を出力する第１の回転検出手段と、

前記織機又はモータが１回転する間にパルス信号を所定の数だけ出力する第２の回転検出手段と、

前記織機又はモータが予め定められた指令回転数にて回転している状態にて、前記織機又はモータが１回転する間に前記第２の回転検出手段から出力されるパルス信号の周期に基づいて織機又はモータのそのときどきの瞬時回転数を求めた後、最大及び最小瞬時回転数を求め、最小瞬時回転数から最大瞬時回転数へ移行する軽負荷移行領域及び最大瞬時回転数から最小瞬時回転数へ移行する重負荷移行領域を求める領域判定手段と、

前記織機又はモータの指令回転数を上昇させるとき、領域判定手段によって求められた軽負荷移行領域内にてインバータ制御手段を用いてモータに出力される指令周波数を上昇させ、前記織機又はモータの指令回転数を下降させるとき、領域判定手段によって求められた重負荷移行領域内にてインバータ制御手段を用いてモータに出力される指令周波数を下降させる周波数制御手段とを備えた織機の回転数制御装置。

【請求項２】　モータによって動作する織機の回転数制御装置において、

前記モータに出力される指令周波数を変化させることにより、該モータの回転数を制御して織機の回転数を制御するインバータ制御手段と、

前記織機又はモータが１回転する毎にパルス信号を出力する第１の回転検出手段と、

前記織機又はモータが１回転する間にパルス信号を所定の数だけ出力する第２の回転検出手段と、

前記織機又はモータが予め定められた指令回転数にて回転している状態にて、前記織機又はモータが１回転する間に前記第２の回転検出手段から出力されるパルス信号の周期に基づいて織機又はモータのそのときどきの瞬時回転数を求めた後、最大及び最小瞬時回転数並びに指令回転数と等しくなる同一瞬時回転数を求め、同一瞬時回転数から最大瞬時回転数を経て再び同一瞬時回転数へ移行する軽負荷領域及び同一瞬時回転数から最小瞬時回転

にてインバータ制御手段を用いてモータに出力さ
令周波数を下降させる周波数制御手段とを備えた
回転数制御装置。

【請求項３】　モータによって動作する織機の回
御装置において、

前記モータに出力される指令周波数を変化させる
より、該モータの回転数を制御して織機の回転数
するインバータ制御手段と、

前記織機又はモータが１回転する毎にパルス信号
する第１の回転検出手段と、

前記織機又はモータが１回転する間にパルス信号
の数だけ出力する第２の回転検出手段と、

前記織機又はモータが予め定められた指令回転数
転している状態にて、前記織機又はモータが１回
間に前記第２の回転検出手段から出力されるパル
の周期に基づいて織機又はモータのそのときどき
回転数を求めた後、最大及び最小瞬時回転数を求
小瞬時回転数から最大瞬時回転数へ移行する軽負
領域及び最大瞬時回転数から最小瞬時回転数へ移
重負荷移行領域を求める領域判定手段と、

前記第２の回転数検出手段からのパルス信号に基
最小瞬時回転数から最大瞬時回転数に移行するま
行時間及び最大瞬時回転数から最小瞬時回転数に
るまでの移行時間を演算する移行時間演算手段と
第１の回転数検出手段からのパルス信号に基づい
又はモータの平均回転数を演算する平均回転数演
と、

前記平均回転数演算手段によって求められたその
織機又はモータの平均回転数と、そのときモータ
されているインバータ制御手段からの指令周波数
たに変更したい新指令回転数とに基づいてインバ
御手段からモータへ出力すべく新指令周波数を演
周波数演算手段と、

前記周波数演算手段によって演算された新指令周
と、インバータ制御手段から出力されている指令
及び移行時間とに基づいて指令周波数を新指令周
変更すべく、インバータ出力周波数の増減率を演
増減率演算手段と、

前記織機又はモータの指令回転数を上昇させると
負荷移行領域にて増減率演算手段にて求められた
でインバータ制御手段を用いてモータに出力され
周波数を上昇させ、前記織機又はモータの指令回
下降させるとき、重負荷移行領域にて増減率演算

するインバータ制御手段と、
前記織機又はモータが１回転する毎にパルス信号を出力する第１の回転検出手段と、
前記織機又はモータが１回転する間にパルス信号を所定の数だけ出力する第２の回転検出手段と、
前記織機又はモータが予め定められた指令回転数にて回転している状態にて、前記織機又はモータが１回転する間に前記第２の回転検出手段から出力されるパルス信号の周期に基づいて織機又はモータのそのときどきの瞬時回転数を求めた後、最大及び最小瞬時回転数並びに指令回転数と等しくなる同一瞬時回転数を求め、同一瞬時回転数から最大瞬時回転数を経て再び同一瞬時回転数へ移行する軽負荷領域及び同一瞬時回転数から最小瞬時回転数を経て再び同一瞬時回転数へ移行する重負荷領域を求める領域判定手段と、
前記第２の回転数検出手段から出力されるパルス信号に基づいて同一瞬時回転数から最大瞬時回転数を経て再び同一瞬時回転数に移行するまでの移行時間及び同一瞬時回転数から最小瞬時回転数を経て再び同一瞬時回転数に移行するまでの移行時間を演算する移行時間演算手段と、
第１の回転数検出手段からのパルス信号に基づいて織機又はモータの平均回転数を演算する平均回転数演算手段と、
前記平均回転数演算手段によって求められたそのときの織機又はモータの平均回転数と、そのときモータに出力されているインバータ制御手段からの指令周波数と、新たに変更したい新指令回転数とに基づいてインバータ制御手段からモータへ出力すべく新指令周波数を演算する周波数演算手段と、
前記周波数演算手段によって演算された新指令周波数と、インバータ制御手段から出力されている指令周波数及び移行時間とに基づいて指令周波数を新指令周波数に変更すべく、インバータ出力周波数の増減率を演算する増減率演算手段と、
前記織機又はモータの指令回転数を上昇させるとき、軽負荷領域内にて増減率演算手段にて求められた増減率でインバータ制御手段を用いてモータから出力される指令周波数を上昇させ、前記織機又はモータの指令回転数を下降させるとき、重負荷領域内にて増減率演算手段にて求められた増減率でインバータ制御手段を用いてモータから出力される指令周波数を下降させる周波数制御手段とを備えた織機の回転数制御装置。

機又はモータの平均回転数を上昇させ、織機又はが１回転するまでの間にて織機又はモータの瞬時が最大となり、その瞬時回転数が最小となるまで荷領域内にて指令回転数を下降させて織機又はモ平均回転数を下降させるようにした織機の回転数法。
【請求項６】　モータによって動作する織機の回御方法において、
織機の負荷変動によって予め定められた指令回転する織機又はモータの瞬時回転数の変化を検出し又はモータが１回転するまでの間にて織機又はモ瞬時回転数が指令回転数に等しいときから最大瞬数を経て再び指令回転数に等しくなる軽負荷領域指令回転数を上昇させて織機又はモータの回転数させ、織機又はモータが１回転するまでの間にてはモータの瞬時回転数が指令回転数に等しいとき小瞬時回転数を経て再び指令回転数に等しくなる領域にて指令回転数を下降させて織機又はモータ数を下降させるようにした織機の回転数制御方法
【発明の詳細な説明】
【０００１】
【産業上の利用分野】本発明は織機の回転数制御び回転数制御方法に係り、詳しくはインバータ制りモータの回転数が制御される織機の回転数制御び回転数制御方法に関するものである。
【０００２】
【従来の技術】従来の織機の回転数制御装置を図す。織機７１のメインシャフト７２にはメインモ３が設けられている。又、メインシャフト７２にコーダ７４が設けられ、メインシャフト７２が１る毎に１つのパルス信号を出力する。又、織機７該織機７１の各種の制御を行う織機制御装置７５られている。織機制御装置７５はメインモータ７御してメインシャフト７２の回転数を制御する回御装置７６に接続されている。又、回転数制御装にはエンコーダ７４からのパルス信号が入力され転数制御装置７６にはメインモータ７３の回転数させるためのインバータ回路７７が設けられるとに、インバータ回路７７を制御する制御部７８がれている。
【０００３】織機制御装置７５は予め記憶されたログラムに基づいてメインシャフト７２を指令回（例えば、６００ｒｐｍ）にて回転させる指令回

が１回転する毎にパルス信号を回転数制御装置７６に出力する。回転数制御装置７６の制御部７８はパルス信号が入力された後、次のパルス信号が入力されるまでの時間を計測し、メインシャフト７２の平均回転数が指令回転数と一致しているか判断する。

【０００５】そして、メインシャフト７２の平均回転数が指令回転数より低い場合、制御部７８はインバータ回路７７のスイッチング制御を速くして周波数を高くし、メインモータ７３の平均回転数を上昇させて指令回転数と同じにする。又、メインシャフト７２の平均回転数が指令回転数より高い場合、制御部７８はインバータ回路７７のスイッチング制御を遅くして周波数を低くし、メインモータ７３の平均回転数を下降させて指令回転数と同じにする。

【０００６】

【発明が解決しようとする課題】ところで、織機７１のメインシャフト７２が１回転する間にある指令回転数から１００ｒｐｍ上昇させたり下降させたりしたい場合、織機制御装置７５は指令回転数信号を回転数制御装置７６に出力する。すると、制御部７６は１００ｒｐｍ上昇又は下降させた指令回転数に基づいてインバータ回路７７をスイッチング制御する。このとき、織機７１のメインシャフト７２は負荷トルクが大きいため、メインモータ７３はすぐに追従することができない。

【０００７】そのため、メインモータ７３に流れる負荷電流が急激に増大する。この負荷電流がインバータ回路７７を構成する図示しないスイッチング素子の定格電流を越えようとすると、制御部７８はスイッチング素子の保護を行うため、インバータ回路７７のスイッチング制御を停止し、織機７１の運転を停止させてしまう。

【０００８】従って、織機７１のメインシャフト７２が１回転する間に急激に指令回転数を上昇させたり下降させたりすることができないという問題がある。又、仮にメインシャフト７２が１回転する間に指令回転数を急激に上昇させたり下降させても、メインシャフト７２の１回転に基づいて回転数を検出するので、メインシャフト７２の正確な回転数を検出することができない。従って、メインシャフト７１が１回転する間に指令回転数を急激に上昇させ、パルス信号に基づいてメインシャフト７２の回転数を検出すると、メインシャフト７２の回転数が新たな指令回転数を上回ってしまってオーバーシュートが発生するという問題がある。同じく、メインシャフト７１が１回転する間に指令回転数を急激に下降さ

化させることができる織機の回転数制御装置及び制御方法を提供することにある。

【００１０】第２の目的は、織機又はモータの回急激に変化させても、回転数にオーバーシュートンダーシュートが発生しないようにすることがで機の回転数制御装置及び回転数制御方法を提供すにある。

【００１１】

【課題を解決するための手段】上記問題点を解決め、請求項１記載の発明は、モータによって動作機の回転数制御装置において、前記モータに出力指令周波数を変化させることにより、該モータのを制御して織機の回転数を制御するインバータ制と、前記織機又はモータが１回転する毎にパルス出力する第１の回転検出手段と、前記織機又はモ１回転する間にパルス信号を所定の数だけ出力すの回転検出手段と、前記織機又はモータが予め定た指令回転数にて回転している状態にて、前記織モータが１回転する間に前記第２の回転検出手段力されるパルス信号の周期に基づいて織機又はモそのときどきの瞬時回転数を求めた後、最大及び時回転数を求め、最小瞬時回転数から最大瞬時回移行する軽負荷移行領域及び最大瞬時回転数から時回転数へ移行する重負荷移行領域を求める領域段と、前記織機又はモータの指令回転数を上昇さき、領域判定手段によって求められた軽負荷移行にてインバータ制御手段を用いてモータに出力さ令周波数を上昇させ、前記織機又はモータの指令を下降させるとき、領域判定手段によって求めら負荷移行領域内にてインバータ制御手段を用いてに出力される指令周波数を下降させる周波数制御を備えたことをその要旨とする。

【００１２】請求項２記載の発明は、モータによ作する織機の回転数制御装置において、前記モー力される指令周波数を変化させることにより、該の回転数を制御して織機の回転数を制御するイン制御手段と、前記織機又はモータが１回転する毎ス信号を出力する第１の回転検出手段と、前記織モータが１回転する間にパルス信号を所定の数だする第２の回転検出手段と、前記織機又はモータ定められた指令回転数にて回転している状態にて織機又はモータが１回転する間に前記第２の回転段から出力されるパルス信号の周期に基づいて織

定手段によって求められた軽負荷領域内にてインバータ制御手段を用いてモータに出力される指令周波数を上昇させ．前記織機又はモータの指令回転数を下降させるとき．領域判定手段によって求められた重負荷領域内にてインバータ制御手段を用いてモータに出力される指令周波数を下降させる周波数制御手段とを備えたことをその要旨とする。

【００１３】請求項３記載の発明は．モータによって動作する織機の回転数制御装置において．前記モータに出力される指令周波数を変化させることにより、該モータの回転数を制御して織機の回転数を制御するインバータ制御手段と、前記織機又はモータが１回転する毎にパルス信号を出力する第１の回転検出手段と、前記織機又はモータが１回転する間にパルス信号を所定の数だけ出力する第２の回転検出手段と．前記織機又はモータが予め定められた指令回転数にて回転している状態にて．前記織機又はモータが１回転する間に前記第２の回転検出手段から出力されるパルス信号の周期に基づいて織機又はモータのそのときどきの瞬時回転数を求めた後．最大及び最小瞬時回転数を求め．最小瞬時回転数から最大瞬時回転数へ移行する軽負荷移行領域及び最大瞬時回転数から最小瞬時回転数へ移行する重負荷移行領域を求める領域判定手段と．前記第２の回転数検出手段からのパルス信号に基づいて最小瞬時回転数から最大瞬時回転数に移行するまでの移行時間及び最大瞬時回転数から最小瞬時回転数に移行するまでの移行時間を演算する移行時間演算手段と、第１の回転数検出手段からのパルス信号に基づいて織機又はモータの平均回転数を演算する平均回転数演算手段と．前記平均回転数演算手段によって求められたそのときの織機又はモータの平均回転数と．そのときモータに出力されているインバータ制御手段からの指令周波数と、新たに変更したい新指令回転数とに基づいてインバータ制御手段からモータへ出力すべく新指令周波数を演算する周波数演算手段と、前記周波数演算手段によって演算された新指令周波数と．インバータ制御手段から出力されている指令周波数及び移行時間とに基づいて指令周波数を新指令周波数に変更すべく、インバータ出力周波数の増減率を演算する増減率演算手段と、前記織機又はモータの指令回転数を上昇させるとき．軽負荷移行領域にて増減率演算手段にて求められた増減率でインバータ制御手段を用いてモータに出力される指令周波数を上昇させ．前記織機又はモータの指令回転数を下降させるとき．重負荷移行領域にて増減率演算手段にて

制御手段と、前記織機又はモータが１回転する毎ス信号を出力する第１の回転検出手段と、前記織モータが１回転する間にパルス信号を所定の数だする第２の回転検出手段と．前記織機又はモータ定められた指令回転数にて回転している状態にて織機又はモータが１回転する間に前記第２の回転段から出力されるパルス信号の周期に基づいて織モータのそのときどきの瞬時回転数を求めた後．び最小瞬時回転数並びに指令回転数と等しくなる時回転数を求め．同一瞬時回転数から最大瞬時回経て再び同一瞬時回転数へ移行する軽負荷領域及瞬時回転数から最小瞬時回転数を経て再び同一瞬数へ移行する重負荷領域を求める領域判定手段と第２の回転数検出手段から出力されるパルス信号いて同一瞬時回転数から最大瞬時回転数を経て再瞬時回転数に移行するまでの移行時間及び同一瞬数から最小瞬時回転数を経て再び同一瞬時回転数するまでの移行時間を演算する移行時間演算手段１の回転数検出手段からのパルス信号に基づいてはモータの平均回転数を演算する平均回転数演算と．前記平均回転数演算手段によって求められたきの織機又はモータの平均回転数と．そのときモ出力されているインバータ制御手段からの指令周と．新たに変更したい新指令回転数とに基づいてータ制御手段からモータへ出力すべく新指令周波算する周波数演算手段と．前記周波数演算手段に演算された新指令周波数と．インバータ制御手段力されている指令周波数及び移行時間とに基づい周波数を新指令周波数に変更すべく．インバータ波数の増減率を演算する増減率演算手段と、前記はモータの指令回転数を上昇させるとき、軽負荷にて増減率演算手段にて求められた増減率でイン制御手段を用いてモータから出力される指令周波昇させ、前記織機又はモータの指令回転数を下降とき．重負荷領域内にて増減率演算手段にて求め増減率でインバータ制御手段を用いてモータかられる指令周波数を下降させる周波数制御手段とをことをその要旨とする。

【００１５】請求項５記載の発明は．モータによ作する織機の回転数制御方法において．織機の負によって予め定められた指令回転数に対する織機ータの瞬時回転数の変化を検出し、織機又はモー回転するまでの間にて織機又はモータの瞬時回転

【００１６】請求項６記載の発明は、モータによって動作する織機の回転数制御方法において、織機の負荷変動によって予め定められた指令回転数に対する織機又はモータの瞬時回転数の変化を検出し、織機又はモータが１回転するまでの間にて織機又はモータの瞬時回転数が指令回転数に等しいときから最大瞬時回転数を経て再び指令回転数に等しくなる軽負荷領域内にて指令回転数を上昇させて織機又はモータの回転数を上昇させ、織機又はモータが１回転するまでの間にて織機又はモータの瞬時回転数が指令回転数に等しいときから最小瞬時回転数を経て再び指令回転数に等しくなる重負荷領域にて指令回転数を下降させて織機又はモータの回転数を下降させるようにしたことをその要旨とする。

【００１７】

【作用】請求項１記載の発明によれば、指令回転数となるようにインバータ制御手段はモータの回転数を制御して織機の回転数を制御する。第１の回転検出手段は織機又はモータが１回転する毎にパルス信号を出力する。第２の回転検出手段は織機又はモータが１回転する間に所定の数のパルス信号を出力する。領域判定手段は第１の回転検出手段から出力されるパルス信号を基準に第２の回転検出手段から出力されるパルス信号のカウントを行うとともに、第２の回転検出手段からのパルス信号の周期に基づいて織機又はモータのそのときどきの瞬時回転数を求める。領域判定手段は織機又はモータが１回転する間において、第２の回転検出手段から出力されるパルス信号のカウント数に基づき最大及び最小瞬時回転数の発生する箇所を求めた後、最小瞬時回転数から最大瞬時回転数へ移行する軽負荷移行領域及び最大瞬時回転数から最小瞬時回転数へ移行する重負荷移行領域を求める。

【００１８】周波数制御手段は織機又はモータが１回転するまでの間に織機又はモータの指令回転数を上昇させるとき、第２の回転検出手段から出力されるパルス信号のカウント数に基づいて軽負荷移行領域を判定し、軽負荷移行領域内でインバータ制御手段を用いてモータに出力される指令周波数を上昇させる。そして、周波数制御手段は織機又はモータが１回転するまでの間に織機又はモータの指令回転数を下降させるとき、第２の回転検出手段から出力されるパルス信号のカウント数に基づいて重負荷移行領域を判定し、重負荷移行領域内でインバータ制御手段を用いてモータに出力される指令周波数を下降させる。

【００１９】従って、織機又はモータが１回転する間に

【００２０】請求項２記載の発明によれば、指令となるようにインバータ制御手段はモータの回転御して織機の回転数を制御する。第１の回転検出織機又はモータが１回転する毎にパルス信号を出る。第２の回転検出手段は織機又はモータが１回間に所定の数のパルス信号を出力する。領域判定第１の回転検出手段から出力されるパルス信号を第２の回転検出手段から出力されるパルス信号のトを行うとともに、第２の回転検出手段からのパ号の周期に基づいて織機又はモータのそのときど時回転数を求める。領域判定手段は織機又はモー回転する間において第２の回転検出手段から出力パルス信号のカウント数に基づき最大及び最小瞬数並びに指令回転数と等しくなる同一瞬時回転数箇所を求めた後、同一瞬時回転数から最大瞬時回経て再び同一瞬時回転数へ移行する軽負荷領域及瞬時回転数から最小瞬時回転数を経て再び同一瞬数へ移行する重負荷領域を求める。

【００２１】周波数制御手段は織機又はモータがするまでの間に織機又はモータの指令回転数を上るとき、第２の回転検出手段から出力されるパルのカウント数に基づいて軽負荷領域を判定し、軽域内でインバータ制御手段を用いてモータに出力指令周波数を上昇させる。そして、周波数制御手機又はモータが１回転するまでの間に織機又はモ指令回転数を下降させるとき、第２の回転検出手出力されるパルス信号のカウント数に基づいて重域を判定し、重負荷領域内でインバータ制御手段てモータに出力される指令周波数を下降させる。

【００２２】従って、織機又はモータが１回転すおける同一瞬時回転数から最大瞬時回転数を経て一瞬時回転数となるまでの間に織機又はモータのの上昇が行われる。織機又はモータが１回転するける同一瞬時回転数から最小瞬時回転数を経て再瞬時回転数となるまでの間に織機又はモータの回下降が行われる。この結果、インバータ制御手段にモータの回転数が追従し、織機又はモータの回効率よく上昇又は下降させることが可能となる。

【００２３】請求項３記載の発明によれば、指令となるようにインバータ制御手段はモータの回転御して織機の回転数を制御する。第１の回転検出織機又はモータが１回転する毎にパルス信号を出る。第２の回転検出手段は織機又はモータが１回

及び最小瞬時回転数の発生する箇所を求めた後、最小瞬時回転数から最大瞬時回転数へ移行する軽負荷移行領域及び最大瞬時回転数から最小瞬時回転数へ移行する重負荷移行領域を求める。

【００２４】又、移行時間演算手段は第２の回転検出手段から出力されるパルス信号に基づいて最小瞬時回転数から最大瞬時回転数に移行するまでの移行時間、最大瞬時回転数から最小瞬時回転数に移行するまでの移行時間を演算する。平均回転数演算手段は第１の回転検出手段からのパルス信号に基づいて織機又はモータの平均回転数を演算する。周波数演算手段はそのときの織機又はモータの平均回転数と、そのときにモータに出力されているインバータ制御手段からの指令周波数と、新たに変更したい指令回転数に基づいてインバータ制御手段からモータへ出力する新指令周波数を演算する。増減率演算手段は移行時間内において指令周波数を新指令周波数に変更するためのインバータ出力周波数の増減率を演算する。

【００２５】周波数制御手段は織機又はモータが１回転するまでの間に織機又はモータの指令回転数を上昇させるとき、第２の回転検出手段から出力されるパルス信号のカウント数に基づいて軽負荷移行領域を判定し、軽負荷移行領域内でインバータ出力周波数の増減率にてインバータ制御手段を用いてモータに出力される指令周波数を上昇させる。そして、周波数制御手段は織機又はモータが１回転するまでの間に織機又はモータの指令回転数を下降させるとき、第２の回転検出手段から出力されるパルス信号のカウント数に基づいて重負荷移行領域を判定し、重負荷移行領域内でインバータ出力周波数の増減率にてインバータ制御手段を用いてモータに出力される指令周波数を下降させる。

【００２６】従って、織機又はモータが１回転する間における最小瞬時回転数から最大瞬時回転数となるまでの間に増減率に基づき、指令周波数を上昇させて織機又はモータの回転数の上昇が行われる。又、織機又はモータが１回転する間の織機における最大瞬時回転数から最小瞬時回転数となるまでの間に増減率に基づき、指令周波数を下降させて織機又はモータの回転数の下降が行われる。この結果、モータの回転数が追従し、織機又はモータの回転数を効率よく上昇又は下降させることが可能となる。

【００２７】請求項４記載の発明によれば、指令回転数となるようにインバータ制御手段はモータの回転数を制

号の周期に基づいて織機又はモータのそのときど時回転数を求める。領域判定手段は第２の回転検から出力されるパルス信号のカウント数に基づい及び最小瞬時回転数並びに指令回転数と等しくな瞬時回転数となる箇所を求めた後、同一瞬時回転最大瞬時回転数を経て再び同一瞬時回転数へ移行負荷領域及び同一瞬時回転数から最小瞬時回転数再び同一瞬時回転数へ移行する重負荷領域を求め

【００２８】又、移行時間演算手段は第２の回転段から出力されるパルス信号に基づいて同一瞬時から最小瞬時回転数を経て再び同一瞬時回転数にるまでの移行時間、同一瞬時回転数から最大瞬時を経て再び同一瞬時回転数に移行するまでの移行演算する。平均回転数演算手段は第１の回転検出らのパルス信号に基づいて織機又はモータの平均を演算する。周波数演算手段はそのときの織機又タの平均回転数と、そのときにモータに出力されインバータ制御手段からの指令周波数と、新たにたい新指令回転数に基づいてインバータ制御手段ータへ出力する新指令周波数を演算する。増減率段は移行時間内において指令周波数を新指令周波更するためのインバータ出力周波数の増減率を演る。

【００２９】周波数制御手段は織機又はモータがするまでの間に織機又はモータの指令回転数を上るとき、第２の回転検出手段から出力されるパルのカウント数に基づいて軽負荷領域を判定し、軽域内でインバータ出力周波数の増幅率にてインバ御手段を用いてモータに出力される指令周波数をせる。そして、周波数制御手段は織機又はモータ転するまでの間に織機又はモータの指令回転数をせるとき、第２の回転検出手段から出力されるパ号のカウント数に基づいて重負荷領域を判定し、領域内でインバータ出力周波数の増幅率にてイン制御手段を用いてモータに出力される指令周波数させる。

【００３０】従って、織機又はモータが１回転すおける同一瞬時回転数から最大瞬時回転数を経て一瞬時回転数となるまでの間に増幅率に基づいて波数が上昇され、織機又はモータの回転数の上昇れる。織機又はモータが１回転する間における同回転数から最小瞬時回転数を経て再び同一瞬時回なるまでの間に増幅率に基づいて指令周波数が下

間にて織機又はモータの瞬時回転数が最小となり、その瞬時回転数が最大となるまでの軽負荷移行領域内にて指令回転数を上昇させて織機又はモータの回転数を上昇させる。織機又はモータが1回転するまでの間にて織機又はモータの瞬時回転数が最大となり、その瞬時回転数が最小となるまでの重負荷移行領域内にて指令回転数を下降させて織機又はモータの回転数を下降させる。

【0032】請求項6記載の発明によれば、織機の負荷変動によって指令回転数に対する織機又はモータの瞬時回転数を検出する。織機又はモータが1回転するまでの間にて織機又はモータの瞬時回転数が指令回転数に等しいときから最大瞬時回転数を経て再び等しくなるまでの軽負荷領域内にて指令回転数を上昇させて織機又はモータの回転数を上昇させる。織機又はモータが1回転するまでの間にて織機又はモータの瞬時回転数が指令回転数に等しいときから最小瞬時回転数を経て再び指令回転数と等しくなるまでの重負荷領域内にて指令回転数を下降させて織機又はモータの回転数を下降させる。

【0033】

【実施例】以下、本発明を具体化した一実施例を図1～図4に基づいて説明する。図1，図2に示すように、織機1にはメインモータ2が設けられている。このメインモータ2は織機1のメインシャフト3に接続されている。前記メインモータ2を回転させることによりメインシャフト3が回転し、織機1を動作させることができるようになっている。又、織機1には織機制御装置5が設けられている。織機制御装置5にはメインシャフト3の回転数を予め定めた指令回転数ｒｐｍ０で回転させる指令回転数信号を出力したり、メインシャフト3以外の織機1に設けられた各種装置を制御するようになっている。その他に、織機制御装置5はメインシャフト3の指令回転数ｒｐｍ０を新指令回転数ｒｐｍ０１，ｒｐｍ０２に変更する新指令回転数信号を出力するようになっている。

【0034】前記メインシャフト3には第1及び第2の回転検出手段としてのエンコーダ6が接続され、メインモータ2によって回転するメインシャフト3の回転数、即ち、織機1の回転数を検出するようになっている。そして、エンコーダ6からはメインシャフト3が1回転すると180個のA相パルス信号ＳＧ１が出力されるようになっている。同じく、エンコーダ6からはメインシャフト3が1回転する毎に1個のZ相パルス信号ＳＧ２が出力されるようになっている。

段、周波数制御手段、移行時間演算手段、平均回算手段及び増減率演算手段としてのコントローラ接続されている。波形整形回路8にはエンコーダのA相及びZ相パルス信号ＳＧ１，ＳＧ２がそれ力される。波形整形回路8はA相及びZ相パルスＧ１、ＳＧ２を変換してコントローラ10に出力うになっている。波形整形回路9には織機制御装ら出力されるメインシャフト3の指令回転数ｒｐ信号が入力される。波形整形回路9は指令回転数０の信号を変換してコントローラ10に出力するなっている。

【0037】又、回転数制御装置7にはインバー手段としてのインバータ制御装置11が設けられる。インバータ制御装置11は整流回路13、平14、スイッチング回路15とから構成されてい流回路13には三相電源12が接続され、交流電流電源に変換される。整流回路13によって直流された直流電源は平滑回路14によって平滑化さ平滑回路14によって平滑化された直流電源はスング回路15に出力される。

【0038】前記コントローラ10にはスイッチ路15の図示しないスイッチング素子をスイッチ御するドライブ回路16が接続されている。そしントローラ10はドライブ回路16を介してスイグ回路15の図示しないスイッチング素子をスイグ制御し、指令周波数ｆ０となる三相交流電源をチング回路15からメインモータ2に出力するよっている。

【0039】織機1の織機制御装置5は、該織機インシャフト3を指令回転数ｒｐｍ０にて回転さ機1を運転させるため、指令回転数ｒｐｍ０に対指令回転数信号を波形整形回路9に出力するようている。波形整形回路9は指令回転数信号を変換ントローラ10に出力する。コントローラ10は転数信号に基づいてメインシャフト3を指令回転ｍ０にて回転させるための指令周波数ｆ０を演算うになっている。この指令周波数ｆ０となるようトローラ10はドライブ回路16を介してインバ御装置11におけるスイッチング回路15の図示スイッチング素子をスイッチング制御するようにいる。すると、指令周波数ｆ０となるインバータメインモータ2に出力されるようになっている。

【0040】指令周波数ｆ０となるインバータ出

1の1パルス信号から次の1パルス信号までのZ相パルス信号時間間隔tzをコントローラ10は計測し、この時間間隔tzに基づいてメインシャフト1の平均回転数rpm1を演算するようになっている。この平均回転数＊

＊rpm1は（1）式に基づいてコントローラ10する。

【0041】

平均回転数rpm1(rpm)＝60／時間間隔tz…（1）式

例えば、Z相パルス信号SG1の1パルス信号から次の1パルス信号までのZ相パルス信号時間間隔tzが0.1（s）となったことをコントローラ10が計測すると、該コントローラ10は（1）式に基づいて平均回転数rpm1を演算する。この場合、メインシャフト3の平均回転数rpm1＝600(rpm)となる。

【0042】ところで、織機1のメインシャフト3が1回転する間に図示しない筬が所定位置から縦糸に通された横糸を打ち込みに行き、その後筬は所定位置に戻る1往復動作を行う。そして、筬の動作により負荷が大きくなる場合、メインモータ2にかかる負荷トルクが大きくなる。すると、メインモータ2のすべり量が増えて瞬時回転数rpm2は減少する。又、筬の動作により負荷が小さくもしくはマイナス負荷になる場合には、メインモータ2にかかる負荷トルクは小さくなる。すると、メインモータ2のすべり量が減少して瞬時回転数rpm2は増加する。従って、筬等の動作によりメインシャフト3が1回転するとき、該メインシャフト3のそのときどきの瞬時回転数rpm2は変化することになる。又、メイ※

※ンシャフト3のそのときどきの回転数の変動特性変化になっている。

【0043】コントローラ10はZ相パルス信号が入力されると、A相パルス信号SG2のカウンセットし、その後順次入力されるA相パルス信号のカウントを開始するようになっている。そしてZ相パルス信号SG1が入力されると、再びカウリセットし、上記と同様のカウントを行うようにいる。又、コントローラ10はZ相パルス信号S入力され、次のZ相パルス信号SG1が入力され即ち、メインシャフト1が1回転する間に180相パルス信号SG2の1周期のA相パルス信号時tAを計測するようになっている。コントローラA相パルス信号時間間隔tAに基づいてメインシ3のそのときどきの瞬時回転数rpm2を演算すになっている。この瞬時平均回転数rpm2は（に基づいてコントローラ10が演算する。

【0044】

瞬時回転数rpm2(rpm)＝60／時間間隔tA×180…（2）式

180：メインシャフト3が1回転したときに出力されるA相パルス信号SG2の数

例えば、A相パルス信号SG2の1周期のA相パルス信号時間間隔tAが0.5（ms）となったことをコントローラ10が計測すると、該コントローラ10は（2）式に基づいて瞬時回転数rpm2を演算する。この場合、メインシャフト3の瞬時回転数rpm2＝約667(rpm)となる。

【0045】コントローラ10はメインシャフト3が1回転する間のそのときどきのメインシャフト3の瞬時回転数rpm2を演算した後、最も瞬時回転数rpm2が最大となる最大瞬時回転数MAXrpm2、最も瞬時回転数rpm2が最小となる最小瞬時回転数MiNrpm2及び瞬時回転数rpm2と指令回転数rpm0とが等しくなる同一瞬時回転数Hrpm2を求める。更に、コントローラ10はZ相パルス信号SG2が入力された後、メインシャフト3が最大瞬時回転数MAXrpm2、最小瞬時回転数MiNrpm2及び同一瞬時回転数

パルス信号SG1のカウント数をN3とする。つA相パルス信号SG1のカウント数がN1となれンシャフト3の瞬時回転数rpm2が最大瞬時回AXrpm2となり、A相パルス信号SG1のカ数がN2となればメインシャフト3の瞬時回転数2が同一瞬時回転数Hrpm2となり、更に、Aス信号SG1のカウント数がN3となればメイント3の瞬時回転数rpm2が最小瞬時回転数MIm2となる。

【0047】そして、コントローラ10は最大瞬数MAXrpm2から最小瞬時回転数MiNrpでの負荷トルクが増加（大きく）する領域を重負領域HGと判定し、最小瞬時回転数MINrpm最大瞬時回転数MAXrpm2までの負荷トルク（小さく）する領域を軽負荷移行領域RGと判定うになっている。

【0048】又、重負荷移行領域HGにおいて、ローラ10はA相パルス信号SG1に基づいて最

るまでの第１軽負荷移行時間ｔｒ１、同一瞬時回転数Ｈｒｐｍ２から最大瞬時回転数ＭＡＸｒｐｍ２となるまでの第２軽負荷移行時間ｔｒ２を演算するようになっている。

【００４９】織機１の織機制御装置５から出力される指令回転数ｒｐｍ０が上昇されて新指令回転数ｒｐｍ０１となると、コントローラ１０は指令回転数ｒｐｍ０と新指令回転数ｒｐｍ０１を比較し、その増加分を演算するようになっている。この増加分をコントローラ１０が軽負荷移行領域ＲＧ内にて増加させるようになっている。＊本実施例においては、コントローラ１０は軽負荷域ＲＧ内における同一瞬時回転数Ｈｒｐｍ２から時回転数ＭＡＸｒｐｍ２の間にて指令回転数ｒｐ新指令回転数ｒｐｍ０１とするようになっている

【００５０】このとき、コントローラ１０は指令ｒｐｍ０、指令周波数ｆ０及び新指令回転数ｒｐ１とに基づいて新指令周波数ｆ１を（３）式に基演算するようになっている。

【００５１】

新指令周波数ｆ１＝ｆ０×ｒｐｍ０１／ｒｐｍ０…（３）式

次に、コントローラ１０は（３）式にて求められた新指令周波数ｆ１から指令周波数ｆ０を差し引き、その増加分を第２軽負荷移行時間ｔｒ２にて割り、新指令周波数ｆ１に変更するための単位時間当たりの周波数の増加率αを演算するようになっている。

【００５２】そして、コントローラ１０はＡ相パルス信号ＳＧ１に基づいて軽負荷移行領域ＲＧにおける同一瞬時回転数Ｈｒｐｍ２から最大瞬時回転数ＭＡＸｒｐｍ２の領域を判定する。本実施例においては、Ｚ相パルス信号ＳＧ２の発生点と軽負荷移行領域ＲＧにおける同一瞬時回転数Ｈｒｐｍ２となる位置が同じであるので、Ａ相及びＺ相パルス信号ＳＧ１、ＳＧ２がコントローラ１０に同時に入力されたとき、該コントローラ１０は軽負荷移行領域ＲＧにおける同一瞬時回転数Ｈｒｐｍ２になったと判断する。すると、コントローラ１０はドライブ回路１６を介してスイッチング回路１５のスイッチング制御を行い、指令周波数ｆ０を新指令周波数ｆ１に変更する。即ち、コントローラ１０は指令周波数ｆ０を単位時間当たりの増加率αに基づいて増加し、第２軽負荷移行※時間ｔｒ２を経過したときには新指令周波数ｆ１ようにドライブ回路１６を介してスイッチング回をスイッチング制御するようになっている。

【００５３】逆に、織機１の織機制御装置５かられる指令回転数ｒｐｍ０が下降されて新指令回転ｍ０２となると、コントローラ１０は指令回転数０と新指令回転数ｒｐｍ０２とを比較し、その減演算するようになっている。この減少分をコント１０が重負荷移行領域ＨＧ内にて減少させるようている。本実施例においては、コントローラ１０荷移行領域ＨＧ内における同一瞬時回転数Ｈｒｐら最小瞬時回転数ＭｉＮｒｐｍ２の間にて指令回ｐｍ０を新指令回転数ｒｐｍ０２とするようになる。

【００５４】このとき、コントローラ１０は指令ｒｐｍ０、指令周波数ｆ０及び新指令回転数ｒｐ２とに基づいて新指令周波数ｆ２を（４）式に基演算するようになっている。

【００５５】

新指令周波数ｆ２＝ｆ０×ｒｐｍ０２／ｒｐｍ０…（４）式

次に、コントローラ１０は指令周波数ｆ０から（４）式にて求められた新指令周波数ｆ２を差し引き、その減少分を第２重負荷移行時間ｔｈ２にて割り、新指令周波数ｆ２に変更するための単位時間当たりの周波数の減少率βを演算するようになっている。

【００５６】そして、コントローラ１０はＡ相パルス信号ＳＧ１に基づいて重負荷移行領域ＨＧにおける同一瞬時周波数Ｈｒｐｍ２から最小瞬時回転数ＭｉＮｒｐｍ２の領域を判定する。この場合、Ｚ相パルス信号ＳＧ２がコントローラ１０に入力されるとコントローラ１０はＡ相パルス信号ＳＧ１のカウントを開始する。そして、Ａ相パルス信号ＳＧ１のカウント数がＮ２となったとき、新指令周波数ｆ２となるようにドライブ回路１６てスイッチング回路１５をスイッチング制御するなっている。

【００５７】又、新指令周波数ｆ１、ｆ２に変更後、コントローラ１０に入力される最初のＺ相パ号ＳＧ２から次のパルス信号ＳＧ２が入力されるコントローラ１０は新指令周波数ｆ１、ｆ２を変いようになっている。そして、新指令周波数ｆ１に変更した後、コントローラ１０に入力される最相パルス信号ＳＧ２と次のパルス信号ＳＧ２とのルス信号時間間隔ｔｚに基づいてメインシャフト均回転数ｒｐｍ１を演算するようになっている。

とを等しくするようにフィードバック制御するようになっている。

【００５９】次に、上記のように構成された織機の回転数制御装置７の作用について説明する。織機１を動作させるべく、織機制御装置５は予め定められた指令回転数ｒｐｍ０に対応した指令回転数信号を波形整形回路９に出力する。波形整形回路９は指令回転数信号を変換してコントローラ１０に出力する。コントローラ１０は指令回転数信号に基づいた指令周波数ｆ０を演算する。コントローラ１０は指令周波数ｆ０となるインバータ出力をスイッチング回路１５から出力するようにドライブ回路１６を介して該スイッチング回路１５の図示しないスイッチング素子をスイッチング制御する。

【００６０】指令周波数ｆ０となるインバータ出力はメインモータ２に出力され，該メインモータ２が動作してメインシャフト３が回転する。メインシャフト３の回転をエンコーダ６が検出する。又、エンコーダ６はメインシャフト３が１回転する毎にＺ相パルス信号ＳＧ２を波形整形回路８に出力する。同様に、エンコーダ６はメインシャフト３が１回転する間に１８０個のＡ相パルス信号ＳＧ１を波形整形回路８に均等間隔にて出力する。波形整形回路８はＡ相及びＺ相パルス信号ＳＧ１、ＳＧ２を変換してコントローラ１０に出力する。そして，コントローラ１０はＺ相パルスＳＧ１のＺ相パルス信号時間間隔ｔｚを計測するとともに、このＺ相パルス信号時間間隔ｔｚ及び（１）式に基づいて平均回転数ｒｐｍ１を演算する。

【００６１】コントローラ１０は平均回転数ｒｐｍ１と指令回転数ｒｐｍ０とが等しいかを比較する。平均回転数ｒｐｍ１と指令回転数ｒｐｍ０とが等しい場合，コントローラ１０はスイッチング回路１５におけるスイッチング素子のスイッチング制御を行うタイミングを固定し，指令周波数ｆ０を固定する。又，平均回転数ｒｐｍ１と指令回転数ｒｐｍ０とが等しくない場合、コントローラ１０はスイッチング回路１５におけるスイッチング素子のスイッチング制御を行うタイミングを変化させ、平均回転数ｒｐｍ１と指令回転数ｒｐｍ０とが等しくなるようにフィードバック制御する。

【００６２】又，図２に示すように，コントローラ１０はメインシャフト３が１回転する間において、該メインシャフト３のそのときどきの瞬時回転数ｒｐｍ２をＡ相パルス信号ＳＧ１の１周期及び（２）式に基づいて演算する。一方，コントローラ１０はＺ相パルス信号ＳＧ２

カウント数、同一瞬時回転数Ｈｒｐｍ２となると
相パルス信号ＳＧ２のカウント数及び最小瞬時回
ｉＮｒｐｍ２となるときのＡ相パルス信号ＳＧ２
ント数を検出する。

【００６３】この実施例の場合、Ａ相パルス信号
のカウント数がＮ１となればメインシャフト３の
転数ｒｐｍ２が最大瞬時回転数ＭＡＸｒｐｍ２と
Ａ相パルス信号ＳＧ１のカウント数がＮ２となれ
ンシャフト３の瞬時回転数ｒｐｍ２が同一瞬時回
ｒｐｍ２となる。更に、Ａ相パルス信号ＳＧ１の
ト数がＮ３となればメインシャフト３の瞬時回転
ｍ２が最小瞬時回転数ＭＩＮｒｐｍ２となる。

【００６４】そして、コントローラ１０は最大瞬
数ＭＡＸｒｐｍ２から最小瞬時回転数ＭｉＮｒｐ
での負荷トルクが増加する領域を重負荷移行領域
判定し、最小瞬時回転数ＭＩＮｒｐｍ２から最大
転数ＭＡＸｒｐｍ２までの負荷トルクが減少する
軽負荷移行領域ＲＧと判定する。

【００６５】又，重負荷移行領域ＨＧにおいて，
ローラ１０はＡ相パルス信号ＳＧ１に基づいて最
回転数ＭＡＸｒｐｍ２から同一瞬時回転数Ｈｒｐ
なるまでの第１重負荷移行時間ｔｈ１，同一瞬時
Ｈｒｐｍ２から最小瞬時回転数ＭｉＮｒｐｍ２と
での第２重負荷移行時間ｔｈ２を演算する。同様
負荷移行領域ＲＧにおいて，コントローラ１０は
ルス信号ＳＧ１に基づいて最小瞬時回転数ＭｉＮ
２から同一瞬時回転数Ｈｒｐｍ２となるまでの第
荷移行時間ｔｒ１、同一瞬時回転数Ｈｒｐｍ２か
瞬時回転数ＭＡＸｒｐｍ２となるまでの第２軽負
時間ｔｒ２を演算する。

【００６６】上記のような処理がコントローラ１
って瞬時に行われ、メインシャフト３の平均回転
ｍ１が指令回転数ｒｐｍ０と等しくなっている状
図３に示すように、時間ｔ１において織機制御装
ら指令回転数ｒｐｍ０よりも高い新指令回転数ｒ
１に対応する新指令回転数信号が波形整形回路９
てコントローラ１０に出力されたとする。すると
トローラ１０は指令回転数ｒｐｍ０と新指令回転
ｍ０１を比較し，その増加分を演算する。この増
コントローラ１０が軽負荷移行領域ＲＧ内におけ
瞬時回転数Ｈｒｐｍ２から最大瞬時回転数ＭＡＸ
２の間にて指令回転数ｒｐｍ０を新指令回転数ｒ
１にする。そのため，コントローラ１０は指令回

波数の増加率αを演算する。そして、コントローラ１０はA相及びZ相パルス信号ＳＧ１，ＳＧ２がコントローラ１０に同時に入力されたとき、該コントローラ１０は軽負荷移行領域ＲＧにおける同一瞬時周波数Ｈｒｐｍ２となったと判定する。すると、コントローラ１０は指令周波数ｆ０を単位時間当たりの増加率αに基づいて増加し、第２軽負荷移行時間ｔｒ２を経過したときには新指令周波数ｆ１となるようにドライブ回路１６を介してスイッチング回路１５をスイッチング制御する。

【００６８】又、新指令周波数ｆ１に変更した後、コントローラ１０に入力される最初のZ相パルス信号ＳＧ２から次のパルス信号ＳＧ２が入力されるまで、コントローラ１０は新指令周波数ｆ１を変更しない。そして、新指令周波数ｆ１に変更した後、コントローラ１０に入力される最初のZ相パルス信号ＳＧ２と次のパルス信号ＳＧ２とのZ相パルス信号時間間隔ｔｚと（１）式に基づいてメインシャフト３の平均回転数ｒｐｍ１を演算する。

【００６９】そして、コントローラ１０は平均回転数ｒｐｍ１と新指令回転数ｒｐｍ０１とが等しくなるか否かを判断し、等しい場合には新指令周波数ｆ１を固定する。又、平均回転数ｒｐｍ１が新指令回転数ｒｐｍ０１と等しくない場合、コントローラ１０は新指令周波数ｆ１を変化させ、平均回転数ｒｐｍ１と新指令回転数ｒｐｍ０１とを等しくするようにフィードバック制御する。

【００７０】又、メインシャフト３の平均回転数ｒｐｍ１が指令回転数ｒｐｍ０と等しくなっている状態で、図４に示すように、時間ｔ２において織機制御装置５から指令回転数ｒｐｍ０よりも低い新指令回転数ｒｐｍ０２に対応する新指令回転数信号が波形整形回路９を介してコントローラ１０に出力されたとする。すると、コントローラ１０は指令回転数ｒｐｍ０と新指令回転数ｒｐｍ０２を比較し、その減少分を演算する。この減少分をコントローラ１０が重負荷移行領域ＨＧ内における同一瞬時回転数Ｈｒｐｍ２から最大瞬時回転数ＭｉＮｒｐｍ２の間にて指令回転数ｒｐｍ０を新指令回転数ｒｐｍ０２にする。そのため、コントローラ１０は指令回転数ｒｐｍ０、指令周波数ｆ０及び新指令回転数ｒｐｍｐ０２とに基づいて新指令周波数ｆ２を（４）式に基づいて演算する。

【００７１】次に、コントローラ１０は（４）式にて求められた新指令周波数ｆ２から指令周波数ｆ０を差し引き、その減少分を第２重負荷移行時間ｔｈ２にて割り、時間当たりの減少率βに基づいて減少し、第２重行時間ｔｈ２を経過したときには新指令周波数ｆるようにドライブ回路１６を介してスイッチング５をスイッチング制御する。

【００７２】又、新指令周波数ｆ２に変更した後トローラ１０に入力される最初のZ相パルス信号から次のパルス信号ＳＧ２が入力されるまで、コーラ１０は新指令周波数ｆ２を変更しない。そし指令周波数ｆ２に変更した後、コントローラ１０される最初のZ相パルス信号ＳＧ２と次のパルスＧ２とのZ相パルス信号時間間隔ｔｚと（１）式いてメインシャフト３の平均回転数ｒｐｍ１を演る。

【００７３】そして、コントローラ１０は平均回ｐｍ１と新指令回転数ｒｐｍ０２とが等しくなるを判断し、等しい場合には新指令周波数ｆ２を固る。又、平均回転数ｒｐｍ１が新指令回転数ｒｐと等しくない場合、コントローラ１０は新指令周２を変化させ、平均回転数ｒｐｍ１と新指令回転ｍ０２とを等しくするようにフィードバック制御

【００７４】従って、メインシャフト３が１回転の軽負荷移行領域ＲＧにてメインシャフト３の平数ｒｐｍ１を新指令回転数ｒｐｍ０１に上昇させる。この結果、メインシャフト３にかかる負荷ト徐々に減少していくときなので、スイッチング回により指令周波数ｆ０を新指令周波数ｆ１に向か昇させてもメインモータ２の回転数はスムーズにてメインシャフト３の平均回転数ｒｐｍ１を新指数ｒｐｍ０１と等しくすることができる。

【００７５】又、メインシャフト３が１回転する負荷移行領域ＨＧにてメインシャフト３の平均回ｐｍ１を新指令回転数ｒｐｍ０２に下降させていの結果、メインシャフト３にかかる負荷トルクは増加していくときなので、スイッチング回路１５指令周波数ｆ０を新指令周波数ｆ２に向かって下てもメインモータ２の回転数はスムーズに下降しンシャフト３の平均回転数ｒｐｍ１を新指令回転ｍ０２と等しくすることができる。

【００７６】この結果、メインシャフト１が１回間に、メインシャフト３の指令回転数ｒｐｍ０と平均回転数ｒｐｍ１を新指令回転数ｒｐｍ０１と平均回転数ｒｐｍ１にすることができる。同様にンシャフト１が１回転する間に、メインシャフト

２を停止させてしまうことを防止することができる。

【００７８】又、本実施例においては、軽負荷移行領域ＲＧにおける同一瞬時回転数Ｈｒｐｍ２から最大瞬時回転数ＭＡＸｒｐｍ２の間でメインシャフト３の回転数を上昇させるようにした。即ち、負荷トルクが小さく、かつ、メインシャフト３の瞬時回転数ｒｐｍ２が指令回転数ｒｐｍ０よりも大きくなったときメインシャフト３の回転数を上昇させるようにした。この結果、メインシャフト３の回転数をスムーズに、かつ、効率よく上昇させて変更させることができる。

【００７９】同様に、本実施例においては、重負荷移行領域ＨＧにおける同一瞬時回転数Ｈｒｐｍ２から最小瞬時回転数ＭＩＮｒｐｍ２の間でメインシャフト３の回転数を上昇させるようにした。即ち、負荷トルクが大きく、かつ、メインシャフト３の瞬時回転数ｒｐｍ２が指令回転数ｒｐｍ０よりも小さくなったときメインシャフト３の回転数を下降させるようにした。この結果、メインシャフト３の回転数をスムーズに、かつ、効率よく下降させて変更させることができる。

【００８０】又、メインシャフト３の回転数を上昇又は下降させるのに適した領域をＡ相パルス信号ＳＧ１に基づいて求め、その領域内での単位時間当たりの増減率α、βに基づいてメインシャフト３の回転数を上昇又は下降させた。即ち、メインシャフト３の回転数を変更する際、Ｚ相パルス信号ＳＧ２を使用せず、Ａ相パルス信号ＳＧ１に基づいて行っている。そして、メインシャフト３の回転数の上昇又は下降が行われ、安定した後、Ｚ相パルス信号ＳＧ２によってメインシャフト３の回転数の制御を行うようにしている。この結果、メインシャフト３の回転数を上昇又は下降させたとき、該メインシャフト３の回転数にオーバーシュートやアンダーシュートを発生させないようにすることができる。

【００８１】本実施例においては、織機１のメインシャフト３の回転数を制御する回転制御装置７に具体化したが、メインモータ２の回転数を制御して織機１の運転を制御する回転数制御装置７としてもよい。

【００８２】本実施例においては、軽負荷移行領域ＲＧにおける同一瞬時回転数Ｈｒｐｍ２から最大瞬時回転数ＭＡＸｒｐｍ２の間にてメインシャフト３の回転数を上昇させるようにした。この他に、軽負荷移行領域ＲＧ全体にてメインシャフト３の回転数を上昇させるようにしてもよい。更に、軽負荷移行領域ＲＧの任意の領域を設定し、その領域内でメインシャフト３の回転数を上昇さ

域内でメインシャフト３の回転数を上昇させるよ
ることも可能である。
【００８４】又、本実施例においては、メインシ
３の回転数を上昇又は下降させるのに適した領域
度に目標となる回転数に変更した。この他に、メ
ャフト３の回転数を上昇又は下降させるのに適し
にて目標となる回転数に段階的に上昇させるよう
もよい。例えば、メインシャフト３の回転数が６
ｐｍとなっており、目標となる回転数が７００ｒ
した場合、メインシャフト３の回転数を上昇させ
適した領域にて取り合えず６５０ｒｐｍに上昇さ
次に、メインシャフト３の回転数を上昇させるの
た領域にて７００ｒｐｍに上昇させる。この場合
段階で６００ｒｐｍの回転数を７００ｒｐｍとし
が、これを更に複数段階に分けてもよい。逆に、
シャフト３の回転数が６００ｒｐｍで、目標とな
数が５００ｒｐｍの場合、メインシャフト３の回
下降させるのに適した領域にて取り合えず５５０
に上昇させ、次のメインシャフト３の回転数を下
るのに適した領域にて５００ｒｐｍに下降させて
い。
【００８５】次に、本発明の別例について説明す
織機１及び回転数制御装置７の構成は図１と同様
め、説明を省略する。図５に示すように、この別
は、メインシャフト３が１回転する間において、
ローラ１０はＡ相パルス信号ＳＧ１に基づいて負
クが減少するときの同一瞬時回転数Ｈｒｐｍ２及
トルクが増加するときの同一瞬時回転数Ｈｒｐｍ
出し、その間の領域を軽負荷領域ＲＡとする。又
トローラ１０はＡ相パルス信号ＳＧ１に基づいて
領域ＲＡ内における予め定められた領域（本実施
いては、最大瞬時回転数ＭＡＸｒｐｍ２から回転
少し、同一瞬時回転数Ｈｒｐｍ２となるまでの間
負荷領域移行時間ｔｒ３を演算する。
【００８６】同様に、図６に示すように、メイン
ト３が１回転する間において、コントローラ１０
パルス信号ＳＧ１に基づいて負荷トルクが増加す
の同一瞬時回転数Ｈｒｐｍ２及び負荷トルクが減
ときの同一瞬時回転数Ｈｒｐｍ２を検出し、その
域を重負荷領域ＨＡとする。又、コントローラ１
相パルス信号ＳＧ１に基づいて重負荷領域ＨＡ内
る予め定められた領域（本実施例においては、最
回転数ＭＩＮｒｐｍ２から回転数が増加し、同一

（３）式に基づいて演算するとともに、その新指令周波数ｆ１から指令周波数ｆ０を差し引き、その増加分を軽負荷領域移行時間ｔｒ３にて割り、新指令周波数ｆ１に変更するための周波数の増加率αを演算する。

【００８８】そして、コントローラ１０はＡ相パルス信号ＳＧ１に基づいて軽負荷領域ＲＡを判定し、その領域内で指令周波数ｆ０を増加率αに基づいて増加させて新指令周波数ｆ１とし、指令回転数ｒｐｍ０を新指令回転数ｒｐｍ０１としてメインシャフト３の平均回転数ｒｐｍ１を上昇させる。

【００８９】この場合、メインシャフト３の負荷トルクが減少する領域からメインシャフト３の回転数の上昇を開始させ、メインシャフト３の負荷トルクが増加していく領域も含んだ範囲で回転数の変更を行っている。しかし、負荷トルクが増加していく領域においてもメインシャフト３の負荷トルクの増加はまだわずかであり、しかも、メインシャフト３の瞬時回転数Ｈｒｐｍ２は指令回転数ｒｐｍ０よりも高い状態にある。この結果、指令周波数ｆ０を新指令周波数ｆ１に上昇してもメインモータ２はその上昇に追従して駆動し、メインシャフト３の回転数を新指令回転数ｒｐｍ０１にスムーズに上昇させることができる。

【００９０】逆に、図６に示すように、メインシャフト３の平均回転数ｒｐｍ１が指令回転数ｒｐｍ０となっている状態で、時間ｔ２にて新指令回転数ｒｐｍ０２となる指示があったとする。すると、コントローラ１０は新指令回転数ｒｐｍ０２に対応する新指令周波数ｆ２を（４）式に基づいて演算するとともに、指令周波数ｆ０から（４）式にて求められた新指令周波数ｆ２を差し引き、その減少分を重負荷領域移行時間ｔｒ４にて割り、新指令周波数ｆ２に変更するための周波数の減少分βを演算する。

【００９１】そして、コントローラ１０はＡ相パルス信号ＳＧ１に基づいて重負荷領域ＨＡを判定し、その領域内で指令周波数ｆ０を減少率βに基づいて減少させて新指令周波数ｆ２とし、指令回転数ｒｐｍ０を新指令回転数ｒｐｍ０２としてメインシャフト３の平均回転数ｒｐｍ１を下降させる。

【００９２】この場合、メインシャフト３の負荷トルクが増加する領域からメインシャフト３の回転数の下降を開始させ、メインシャフト３の負荷トルクが減少していく領域も含んだ範囲で回転数の変更を行っている。しかし、負荷トルクが減少していく領域においてもメインシ

【００９３】この別例においては、軽負荷領域Ｒ
メインシャフト３の回転数を上昇させたが、この
の任意の領域を設定し、その任意の領域にてメイ
フト３の回転数を上昇させるようにしてもよい。
く、重負荷領域ＨＡにてメインシャフト３の回転
降させたが、この領域内の任意の領域を設定し、
意の領域にてメインシャフト３の回転数を下降さ
うにしてもよい。

【００９４】本実施例においては、メインシャフ
１回転する間にＡ相パルス信号ＳＧ１が１８０個
れるエンコーダ６を使用したが、このＡ相パルス
Ｇ１の数は必要に応じて変更してもよい。

【００９５】又、本実施例においては、Ａ相パル
ＳＧ１のカウント数に基づいて最大瞬時回転数Ｍ
ｐｍ２、最小瞬時回転数ＭＩＮｒｐｍ２、同一瞬
数Ｈｒｐｍ２、重負荷移行領域ＨＧ、軽負荷移行
Ｇ、重負荷領域ＨＡ、軽負荷領域ＲＡを検出した
したりした。この他に、Ａ相パルス信号ＳＧ１の
ト数によってメインシャフト３がＺ相パルス信号
を基準に何度回転したとき、最大瞬時回転数ＭＡ
ｍ２、最小瞬時回転数ＭＩＮｒｐｍ２、同一瞬時
Ｈｒｐｍ２が発生するかを検出し、角度に基づい
荷移行領域ＨＧ、軽負荷移行領域ＲＧ、重負荷領
Ａ、軽負荷領域ＲＡを判定するようにしてもよい

【００９６】

【発明の効果】以上詳述したように、請求項１記
明によれば、織機又はモータが１回転するまでの
負荷移行領域、重負荷移行領域を判定し、軽負荷
域内でインバータ制御手段からモータに出力され
周波数を急激に上昇させるので、織機又はモータ
数をスムーズに上昇させて追従させることができ
又、重負荷移行領域内でインバータ制御手段から
に出力される指令周波数を急激に下降させるので
又はモータの回転数をスムーズに下降させて追従
ことができる。

【００９７】請求項２記載の発明によれば、織機
ータが１回転するまでの間の軽負荷領域、重負荷
判定し、負荷が小さい軽負荷領域内でインバータ
段からモータに出力される指令周波数を急激に上
るので、織機又はモータの回転数をスムーズに上
て追従させることができる。又、負荷が大きい重
域内でインバータ制御手段からモータに出力され
周波数を急激に下降させるので、織機又はモータ

シュートを発生させないようにすることができる。又、重負荷移行領域内で増減率演算手段により求められた増減率にてインバータ制御手段からモータに出力される指令周波数を急激に下降させるので、織機又はモータの回転数をスムーズに下降させてアンダーシュートを発生させないようにすることができる。

【0099】請求項4記載の発明によれば、織機又はモータが1回転するまでの間の軽負荷領域、重負荷領域を判定し、負荷が小さい軽負荷領域内で増減率演算手段により求められた増減率にてインバータ制御手段からモータに出力される指令周波数を急激に上昇させるので、織機又はモータの回転数をスムーズに上昇させてオーバーシュートを発生させないようにすることができる。又、負荷が大きい重負荷領域内で増減率演算手段により求められた増減率にてインバータ制御手段からモータに出力される指令周波数を急激に下降させるので、織機又はモータの回転数をスムーズに下降させてアンダーシュートを発生させないようにすることができる。

【0100】請求項5記載の発明によれば、織機又はモータが1回転するまでの間の軽負荷移行領域内にて指令回転数を急激に上昇させるので織機又はモータの回転数をスムーズに上昇させることができる。又、織機又はモータが1回転するまでの間の重負荷移行領域内にて指令回転数を急激に下降させるので、織機又はモータの回転数をスムーズに下降させることができる。

【0101】請求項6記載の発明によれば、織機又はモータが1回転するまでの間の軽負荷領域内にて指令回転数を急激に上昇させるので織機又はモータの回転数をスムーズに上昇させることができる。又、織機又はモータが1回転するまでの間の重負荷領域内にて指令回転数を急激に下降させるので、織機又はモータの回転数をスムーズに下降させることができる。

【図面の簡単な説明】

【図1】織機におけるメインシャフトの回転数の制御を行う回転数制御装置の電気的構成を示す電気ブロック図である。

【図2】メインシャフトが1回転する間のそのときの瞬時回転数、メインシャフトの負荷トルク、A、Z相パルス信号を示す説明図である。

【図3】軽負荷移行領域内にてメインシャフトのを上昇させることを説明する説明図である。

【図4】重負荷移行領域内にてメインシャフトのを下降させることを説明する説明図である。

【図5】軽負荷領域内にてメインシャフトの回転昇させることを説明する説明図である。

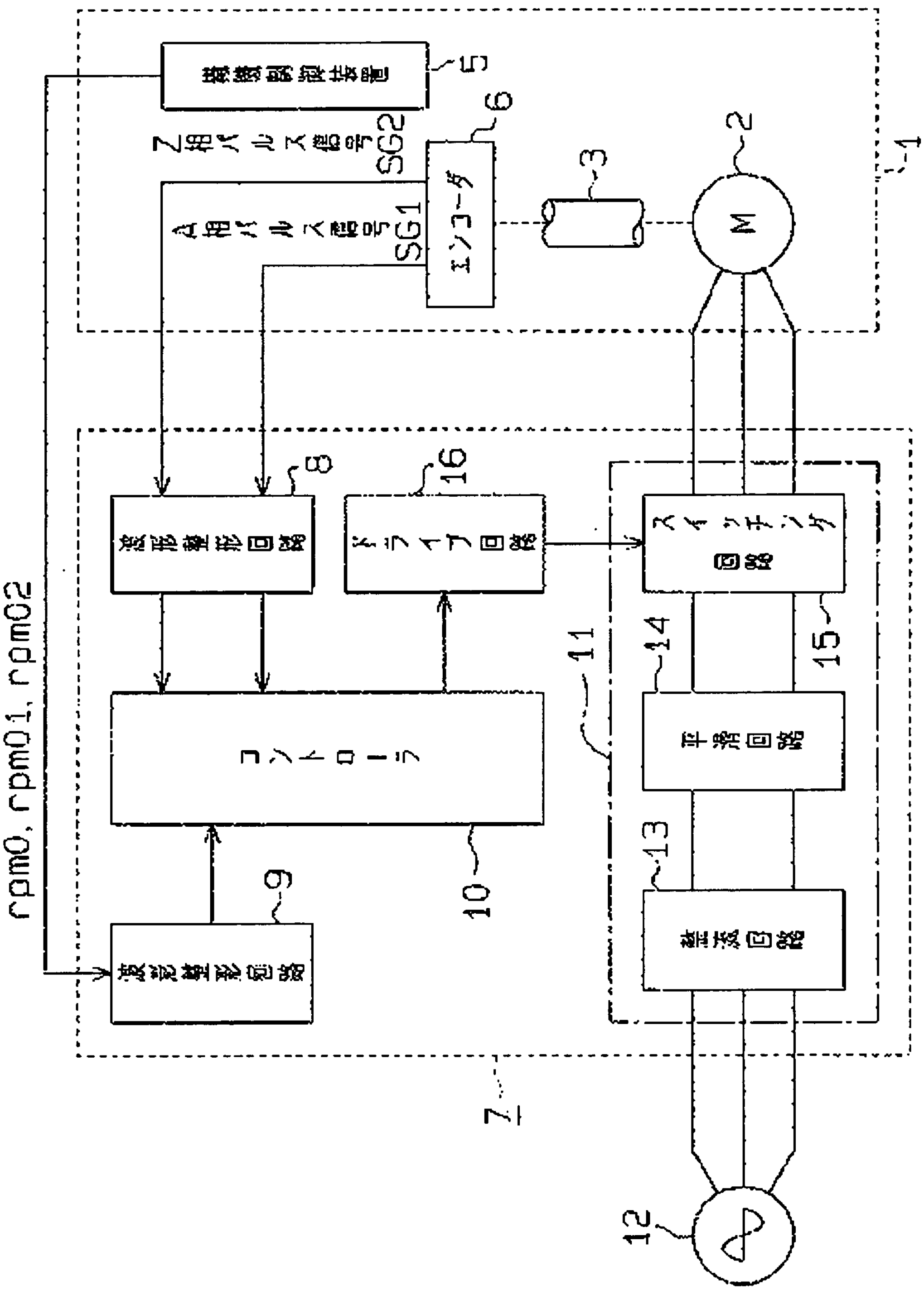
【図6】重負荷領域内にてメインシャフトの回転降させることを説明する説明図である。

【図7】従来の織機におけるメインシャフトの回制御する回転数制御装置の電気的構成を示す電気ク図である。

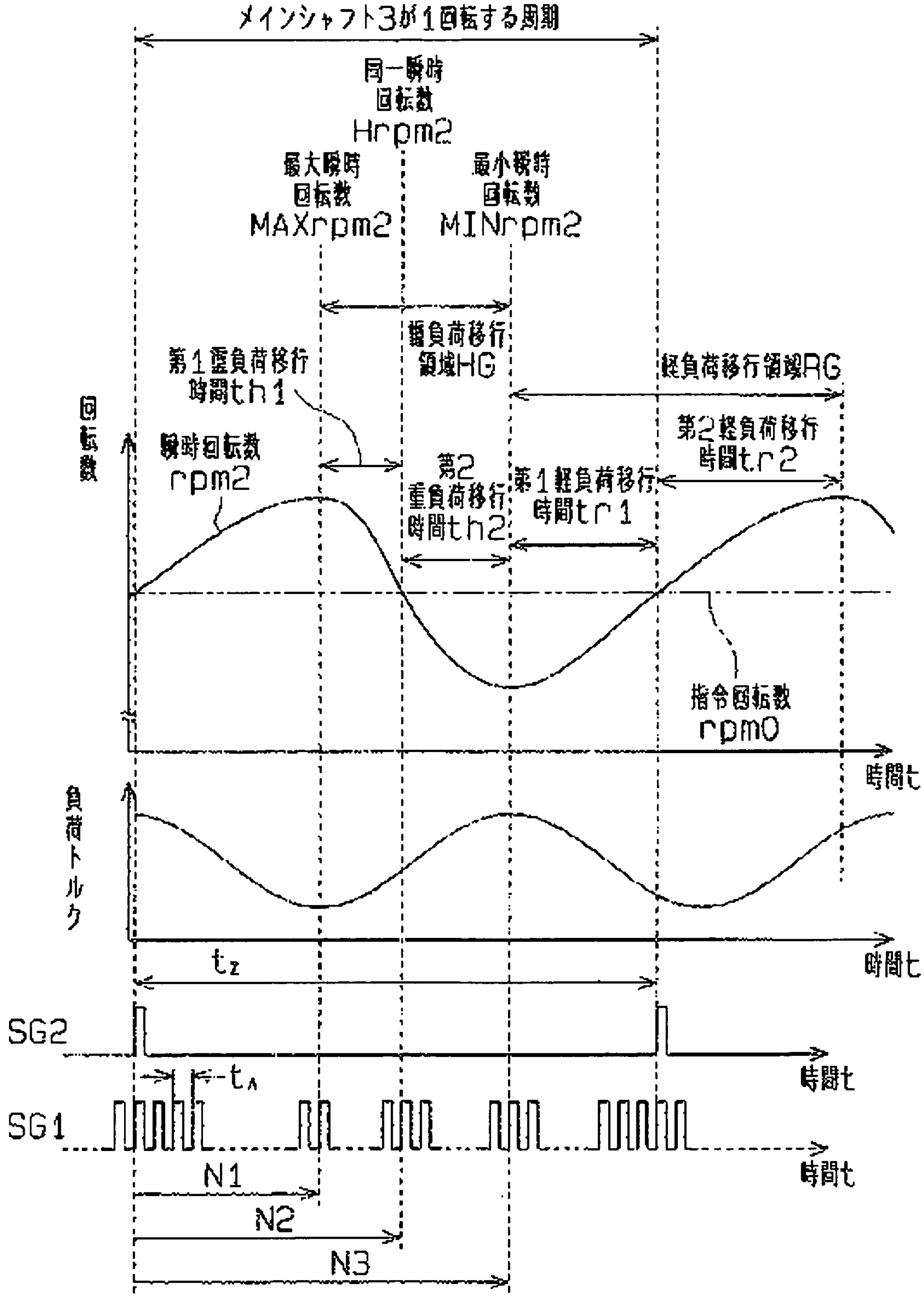
【符号の説明】

1…織機、2…（メイン）モータ、6…第1及び回転数検出手段としてのエンコーダ、7…回転数置、10…領域判定手段、周波数制御手段、移行算手段及び平均回転数演算手段としてのコントロ11…インバータ制御手段としてのインバータ装G1…A相パルス信号、SG2…Z相パルス信号…指令周波数、f1，f2…新指令周波数、rp指令回転数、rpm1…平均回転数、rpm2…転数、rpm01，rpm02…新指令回転数、rpm2…最大瞬時回転数、MiNrpm2…最回転数、Hrpm2…同一瞬時回転数、RG…軽行領域、HG…重負荷移行領域、RA…軽負荷領A…重負荷領域、tr1…移行時間としての第1移行時間、tr2…移行時間としての第2軽負荷間、th1…移行時間としての第1重負荷移行時h2…移行時間としての第2重負荷移行時間、t移行時間としての軽負荷領域移行時間、tr4…間としての重負荷領域移行時間、α…増減率とし加率、β…増減率としての減少率

【図1】

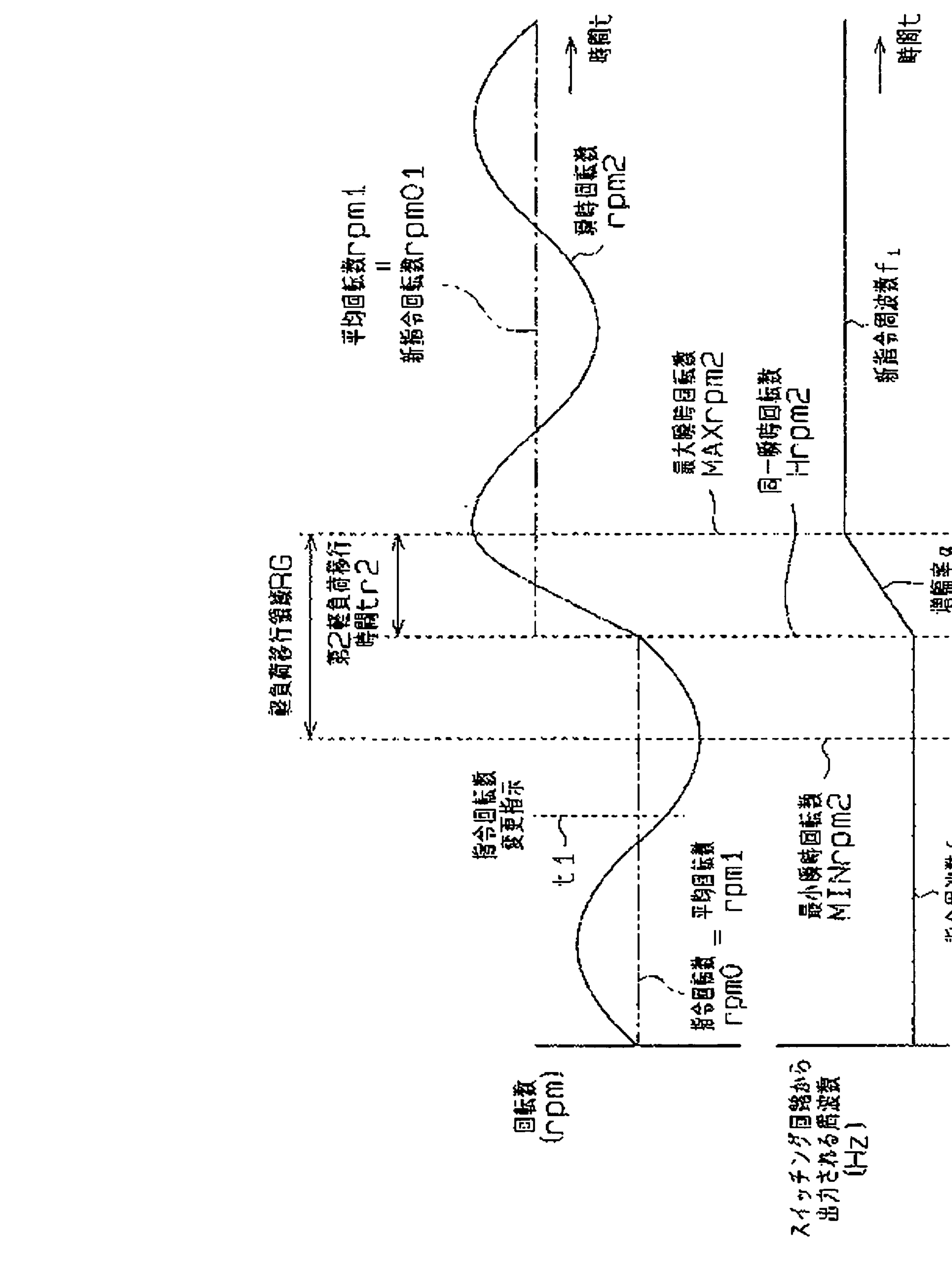


【図2】

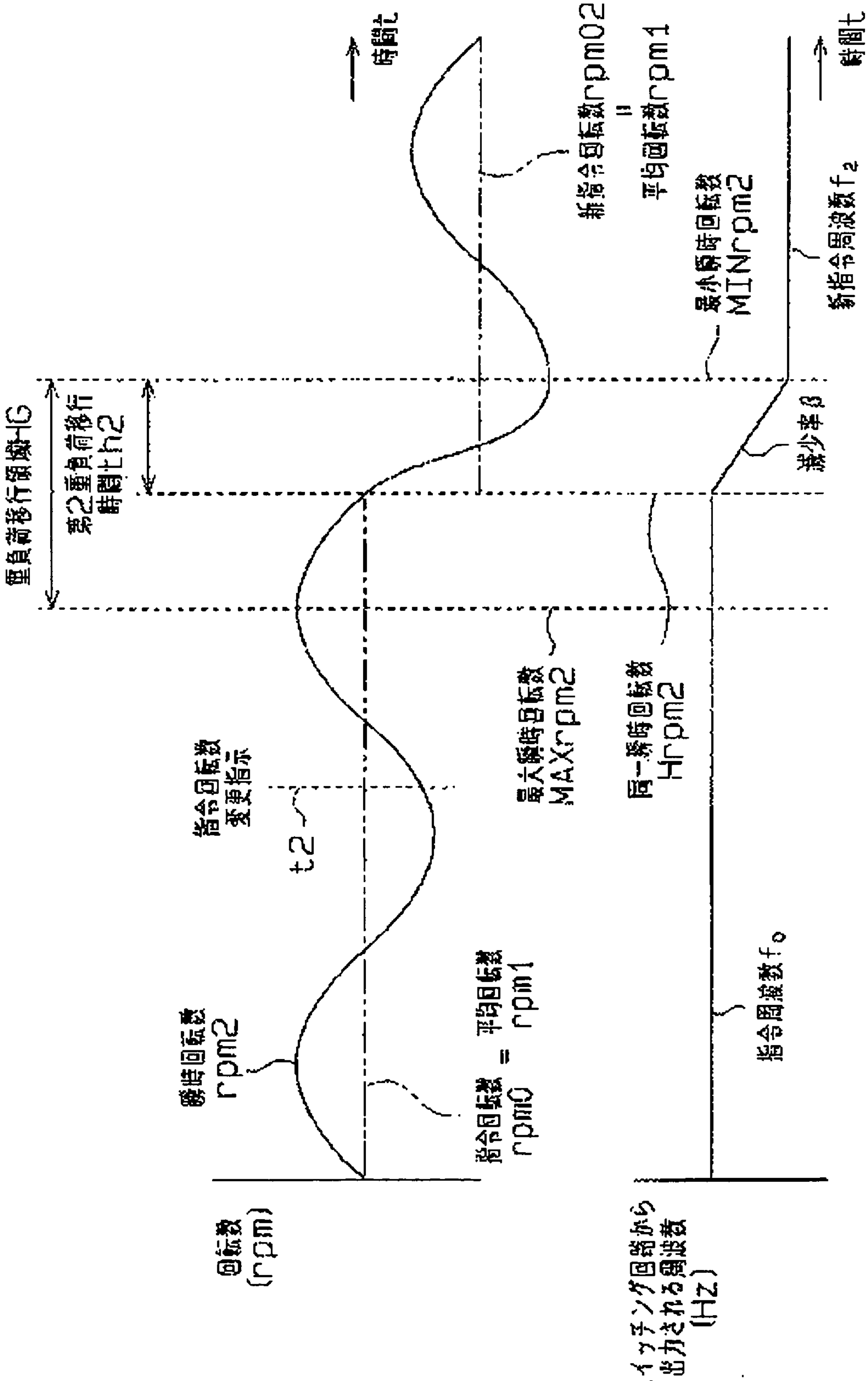


メインシャフト3が1回転する周期
同一瞬時
回転数
Hrpm2
最大瞬時
回転数
MAXrpm2
最小瞬時
回転数
MINrpm2
重負荷移行
領域HG
第1重負荷移行
時間th1
軽負荷移行領域RG
回転数
瞬時回転数
rpm2
第2
重負荷移行
時間th2
第1軽負荷移行
時間tr1
第2軽負荷移行
時間tr2
指令回転数
rpm0
時間t
負荷トルク
時間t
t_z
SG2
時間t
t_A
SG1
時間t
N1
N2
N3

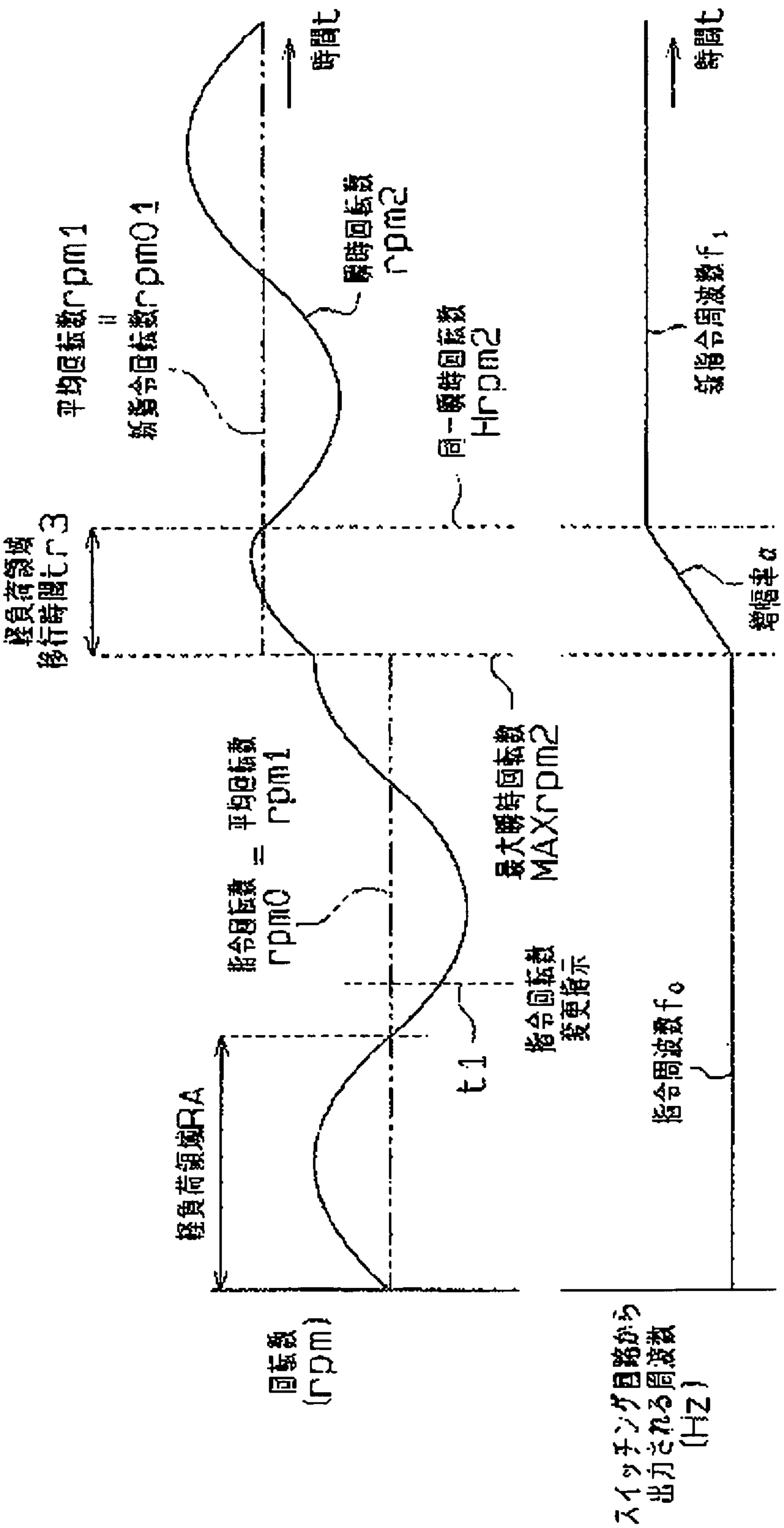
【図3】


回転数
(rpm)
スイッチング回路から
出力される周波数
(Hz)
指令回転数
rpm0
=
平均回転数
rpm1
t1
指令回転数
変更指示
軽負荷移行領域RG
第2軽負荷移行
時間tr2
平均回転数rpm1
=
新指令回転数rpm01
瞬時回転数
rpm2
時間t
最大瞬時回転数
MAXrpm2
同一瞬時回転数
Hrpm2
最小瞬時回転数
MINrpm2
指令周波数f0
新指令周波数f1
増幅率α
時間t

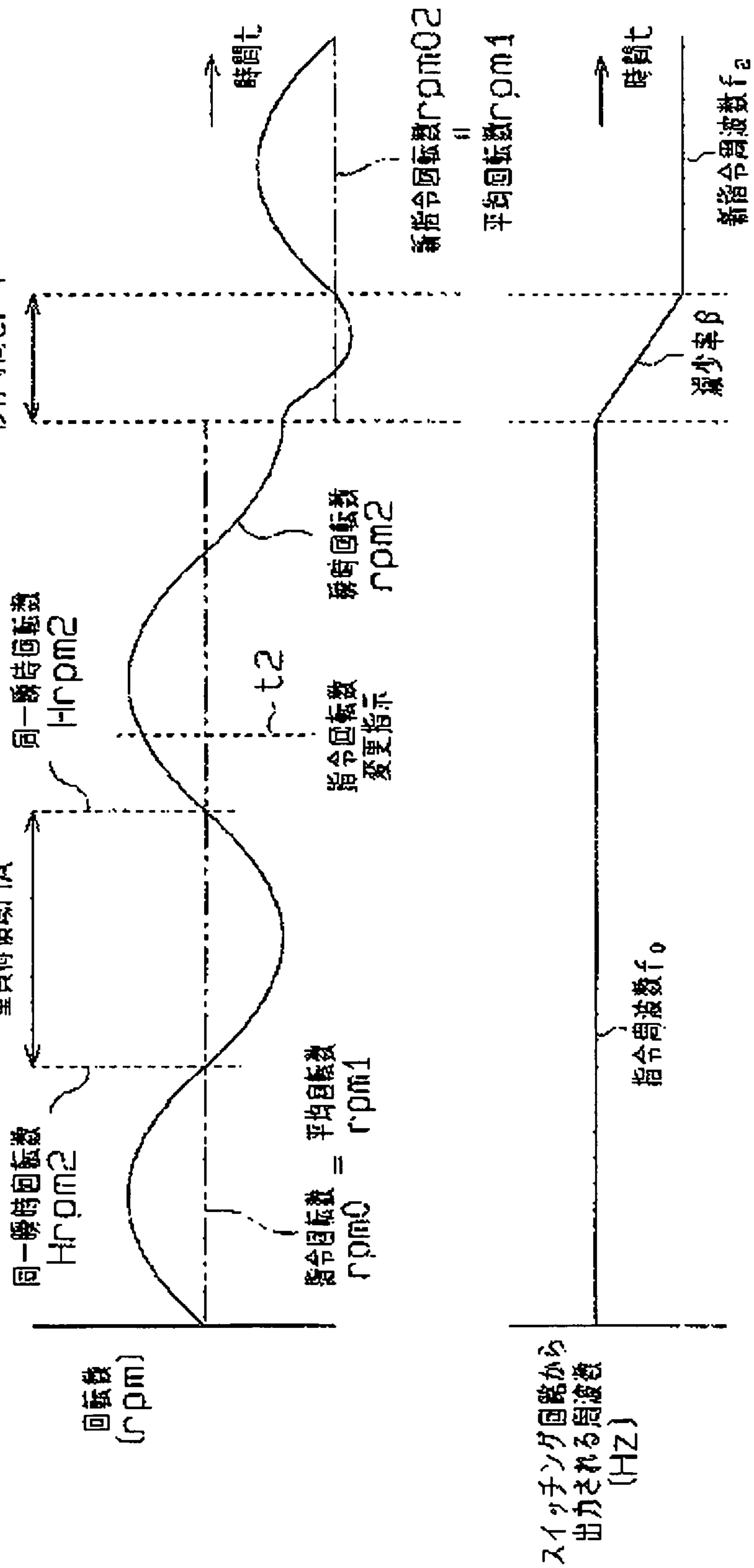
【図4】


回転数 (rpm)
瞬時回転数 rpm2
指令回転数 rpm0 = 平均回転数 rpm1
指令回転数変更指示
t2
最大瞬時回転数 MAXrpm2
同一瞬時回転数 Hrpm2
重負荷移行領域HG
第2重負荷移行時間th2
最小瞬時回転数 MINrpm2
新指令回転数rpm02
=
平均回転数rpm1
時間t
スイッチング回路から出力される周波数 (Hz)
指令周波数 f0
減少率β
新指令周波数 f2
時間t

【図5】

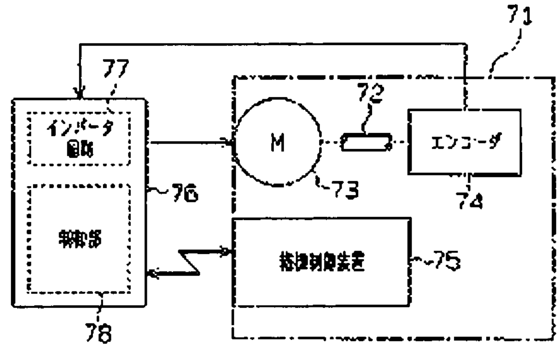

回転数
(rpm)
スイッチング回路から
出力される周波数
(Hz)
軽負荷領域RA
t1
指令回転数
変更指示
指令回転数
rpm0
=
平均回転数
rpm1
最大瞬時回転数
MAXrpm2
軽負荷領域
移行時間tr3
同一瞬時回転数
Hrpm2
平均回転数rpm1
=
新指令回転数rpm01
瞬時回転数
rpm2
時間t
指令周波数f0
増幅率α
新指令周波数f1
時間t

【図6】



回転数
(rpm)
同一瞬時回転数
Hrpm2
指令回転数 = 平均回転数
rpm0 = rpm1
重負荷領域HA
同一瞬時回転数
Hrpm2
指令回転数
変更指示
t2
瞬時回転数
rpm2
重負荷領域
移行時間tr4
新指令回転数rpm02
=
平均回転数rpm1
時間t
スイッチング回路から
出力される周波数
(HZ)
指令周波数f0
減少率β
新指令周波数f2
時間t

【図7】



JP 8-60496

* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] By changing the command frequency outputted to said motor in the revolving-speed-control equipment of the weaving machine which operates by the motor The inverter control means which controls the engine speed of this motor and controls the engine speed of a weaving machine, The 1st rotation detection means which outputs a pulse signal whenever said weaving machine or motor rotates one time, 2nd rotation detection means by which only a predetermined number outputs a pulse signal while said weaving machine or motor rotates one time, In the condition that said weaving machine or motor is rotating at the command rotational frequency defined beforehand After asking for the occasional instant rotational frequency of a weaving machine or a motor based on the period of the pulse signal outputted from said 2nd rotation detection means while said weaving machine or motor rotates one time, A field judging means to ask for the maximum and the minimum instant rotational frequency, and to ask for the heavy-loading transitional zone which shifts to the minimum instant rotational frequency from the light load transitional zone and the maximum instant rotational frequency which shift to the maximum instant rotational frequency from the minimum instant rotational frequency, When raising the command engine speed of said weaving machine or a motor, the command frequency outputted to a motor using an inverter control means within the light load transitional zone called for by the field judging means is raised. Revolving-speed-control equipment of the weaving machine equipped with a frequency control means to drop the command frequency outputted to a motor using an inverter control means within the heavy-loading transitional zone called for by the field judging means when dropping the command engine speed of said weaving machine or a motor.
[Claim 2] By changing the command frequency outputted to said motor in the revolving-speed-control equipment of the weaving machine which operates by the motor The inverter control means which controls the engine speed of this motor and controls the engine speed of a weaving machine, The 1st rotation detection means which outputs a pulse signal whenever said weaving machine or motor rotates one time, 2nd rotation detection means by which only a predetermined number outputs a pulse signal while said weaving machine or motor rotates one time, In the condition that said weaving machine or motor is rotating at the command rotational frequency defined beforehand After asking for the occasional instant rotational frequency of a weaving machine or a motor based on the period of the pulse signal outputted from said 2nd rotation detection means while said weaving machine or motor rotates one time, Max and the minimum instant rotational frequency list are asked for the same instant rotational frequency which becomes equal to a command rotational frequency. A field judging means to ask for the heavy-loading field which shifts to the same instant rotational frequency again through the minimum instant rotational frequency from the light load field which shifts to the same instant rotational frequency again through the maximum sequential rotational frequency from the same instant rotational frequency, and the same instant rotational frequency, When raising the command engine speed of said weaving machine or a motor, the command frequency outputted to a motor using an inverter control means in the light load field called for by the field judging means is raised. Revolving-speed-control equipment of the weaving machine equipped with a frequency control means to drop the command frequency outputted to a motor using an inverter control means in the heavy-loading field called for by the field judging means when dropping the command engine speed of said weaving machine or a motor.
[Claim 3] By changing the command frequency outputted to said motor in the revolving-speed-control equipment of the weaving machine which operates by the motor The inverter control means which controls the engine speed of this motor and controls the engine speed of a weaving machine, The 1st rotation detection means which outputs a pulse signal whenever said weaving machine or motor rotates one time, 2nd rotation detection means by which only a predetermined number outputs a pulse signal while said weaving machine or

motor rotates one time, In the condition that said weaving machine or motor is rotating at the command rotational frequency defined beforehand After asking for the occasional instant rotational frequency of a weaving machine or a motor based on the period of the pulse signal outputted from said 2nd rotation detection means while said weaving machine or motor rotates one time, A field judging means to ask for the maximum and the minimum instant rotational frequency, and to ask for the heavy-loading transitional zone which shifts to the minimum instant rotational frequency from the light load transitional zone and the maximum instant rotational frequency which shift to the maximum instant rotational frequency from the minimum instant rotational frequency, A transit time operation means to calculate transit time until it shifts to the minimum instant rotational frequency from transit time and the maximum instant rotational frequency until it shifts to the maximum instant rotational frequency from the minimum instant rotational frequency based on the pulse signal from said 2nd rotational frequency detection means, An average rotational frequency operation means to calculate the average rotational frequency of a weaving machine or a motor based on the pulse signal from the 1st rotational frequency detection means, That weaving machine when asking with said average rotational frequency operation means, or the average rotational frequency of a motor, The command frequency from the inverter control means currently then outputted to the motor, A frequency operation means to calculate a new command frequency that it should output to a motor from an inverter control means based on a new command engine speed to newly change, That a command frequency should be changed into a new command frequency based on the new command frequency calculated with said frequency operation means, and the command frequency and transit time which are outputted from the inverter control means When raising the command rotational frequency of a percent-change operation means to calculate the percent change of an inverter output frequency, and a said weaving machine or a motor, When raising the command frequency outputted to a motor using an inverter control means by the percent change called for with the percent-change operation means in the light load transitional zone and dropping the command rotational frequency of said weaving machine or a motor, Revolving-speed-control equipment of the weaving machine equipped with a frequency control means to drop the command frequency outputted to a motor using an inverter control means by the percent change called for with the percent-change operation means in the heavy-loading transitional zone.

[Claim 4] By changing the command frequency outputted to said motor in the revolving-speed-control equipment of the weaving machine which operates by the motor The inverter control means which controls the engine speed of this motor and controls the engine speed of a weaving machine, The 1st rotation detection means which outputs a pulse signal whenever said weaving machine or motor rotates one time, 2nd rotation detection means by which only a predetermined number outputs a pulse signal while said weaving machine or motor rotates one time, In the condition that said weaving machine or motor is rotating at the command rotational frequency defined beforehand After asking for the occasional instant rotational frequency of a weaving machine or a motor based on the period of the pulse signal outputted from said 2nd rotation detection means while said weaving machine or motor rotates one time, Max and the minimum instant rotational frequency list are asked for the same instant rotational frequency which becomes equal to a command rotational frequency. A field judging means to ask for the heavy-loading field which shifts to the same instant rotational frequency again through the minimum instant rotational frequency from the light load field which shifts to the same instant rotational frequency again through the maximum instant rotational frequency from the same instant rotational frequency, and the same instant rotational frequency, Transit time until it shifts to the same instant rotational frequency again through the minimum instant rotational frequency from transit time and the same instant rotational frequency until it shifts to the same instant rotational frequency again through the maximum instant rotational frequency based on the pulse signal outputted from said 2nd rotational frequency detection means from the same instant rotational frequency A transit time operation means to calculate, and an average rotational frequency operation means to calculate the average rotational frequency of a weaving machine or a motor based on the pulse signal from the 1st rotational frequency detection means, That weaving machine when asking with said average rotational frequency operation means, or the average rotational frequency of a motor, The command frequency from the inverter control means currently then outputted to the motor, A frequency operation means to calculate a new command frequency that it should output to a motor from an inverter control means based on a new command engine speed to newly change, That a command frequency should be changed into a new command frequency based on the new command frequency calculated with said frequency operation means, and the command frequency and transit time which are outputted from the inverter control means When raising the command rotational frequency of a percent-change operation means to calculate the percent change of an inverter output frequency, and a said weaving machine or a motor, When raising the command frequency

outputted from a motor using an inverter control means by the percent change called for with the percent-change operation means in a light load field and dropping the command rotational frequency of said weaving machine or a motor, Revolving-speed-control equipment of the weaving machine equipped with a frequency control means to drop the command frequency outputted from a motor using an inverter control means by the percent change called for with the percent-change operation means in a heavy-loading field.

[Claim 5] In the revolving-speed-control approach of a weaving machine of operating by the motor, change of the instant rotational frequency of the weaving machine to the command rotational frequency beforehand defined by the load effect of a weaving machine or a motor is detected. The instant rotational frequency of a weaving machine or a motor serves as min until a weaving machine or a motor rotates one time. Within the light load transitional zone until the instant rotational frequency serves as max, raise a command rotational frequency and the average rotational frequency of a weaving machine or a motor is raised. The revolving-speed-control approach of a weaving machine of dropping a command rotational frequency and having made it drop the average rotational frequency of a weaving machine or a motor in a heavy-loading field until the instant rotational frequency of a weaving machine or a motor serves as max until a weaving machine or a motor rotates one time, and the instant rotational frequency serves as min.

[Claim 6] In the revolving-speed-control approach of a weaving machine of operating by the motor, change of the instant rotational frequency of the weaving machine to the command rotational frequency beforehand defined by the load effect of a weaving machine or a motor is detected. When the instant rotational frequency of a weaving machine or a motor is equal to a command rotational frequency, raise a command rotational frequency from from in the light load field which becomes equal to a command rotational frequency again through the maximum instant rotational frequency until a weaving machine or a motor rotates one time, and the rotational frequency of a weaving machine or a motor is raised. The revolving-speed-control approach of a weaving machine of dropping a command rotational frequency from from in the heavy-loading field which becomes equal to a command rotational frequency again through the minimum instant rotational frequency until a weaving machine or a motor rotates one time, and having made it drop the rotational frequency of a weaving machine or a motor when the instant rotational frequency of a weaving machine or a motor was equal to a command rotational frequency.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the revolving-speed-control equipment and the revolving-speed-control approach of a weaving machine, and relates to the revolving-speed-control equipment and the revolving-speed-control approach of a weaving machine that the engine speed of a motor is controlled by inverter control in detail.
[0002]
[Description of the Prior Art] The revolving-speed-control equipment of the conventional weaving machine is shown in drawing 7 . The Maine motor 73 is formed in the main shaft 72 of a weaving machine 71. Moreover, an encoder 74 is formed in a main shaft 72, and whenever a main shaft 72 rotates one time, one pulse signal is outputted. moreover -- a weaving machine 71 -- this -- the weaving machine which performs various kinds of control of a weaving machine 71 -- the control unit 75 is formed. a weaving machine -- the control unit 75 is connected to the revolving-speed-control equipment 76 which controls the Maine motor 73 and controls the rotational frequency of a main shaft 72. Moreover, the pulse signal from an encoder 74 is inputted into revolving-speed-control equipment 76. While the inverter circuit 77 for changing the engine speed of the Maine motor 73 to revolving-speed-control equipment 76 is formed, the control section 78 which controls an inverter circuit 77 is formed.
[0003] a weaving machine -- a control unit 75 outputs the command rotational frequency signal which rotates a main shaft 72 at a command rotational frequency (for example, 600rpm) based on the activity program memorized beforehand to revolving-speed-control equipment 76. The control section 78 of revolving-speed-control equipment 76 carries out switching control of the inverter circuit 77 to the timing based on a command engine-speed signal, and outputs the power source used as a predetermined frequency to the Maine motor 73. Therefore, the Maine motor 73 is controlled and a main shaft 72 rotates at a command rotational frequency.
[0004] Moreover, an encoder 74 outputs a pulse signal to revolving-speed-control equipment 76, whenever a main shaft 72 rotates one time. It judges whether after a pulse signal is inputted, the average rotational frequency of the control section 78 of revolving-speed-control equipment 76 of a main shaft 72 corresponds with a command rotational frequency by measuring time amount until the following pulse signal is inputted.
[0005] And when the average engine speed of a main shaft 72 is lower than a command engine speed, a control section 78 makes switching control of an inverter circuit 77 quick, makes a frequency high, raises the average engine speed of the Maine motor 73, and makes it the same as a command engine speed. Moreover, when the average engine speed of a main shaft 72 is higher than a command engine speed, a control section 78 makes switching control of an inverter circuit 77 late, makes a frequency low, drops the average engine speed of the Maine motor 73, and makes it the same as a command engine speed.
[0006]
[Problem(s) to be Solved by the Invention] by the way, the case where carry out a 100rpm rise from the command rotational frequency which is while the main shaft 72 of a weaving machine 71 rotates one time, or it descends [make / it / **] -- a weaving machine -- a control unit 75 outputs a command rotational frequency signal to revolving-speed-control equipment 76. Then, a control section 76 carries out switching control of the inverter circuit 77 based on the command engine speed dropped [which drops and 100-rpm-rose]. At this time, since the main shaft 72 of a weaving machine 71 has large load torque, the Maine motor 73 cannot be followed immediately.
[0007] Therefore, the load current which flows on the Maine motor 73 increases rapidly. If this load current tends to exceed the rated current of the switching element which constitutes an inverter circuit 77 and which is not illustrated, since a control section 78 protects a switching element, it will suspend the switching control of an inverter circuit 77, and will stop operation of a weaving machine 71.
[0008] Therefore, while the main shaft 72 of a weaving machine 71 rotates one time, the problem of the ability to raise a command rotational frequency rapidly or not make it descending is. Moreover, even if it raises a command rotational frequency rapidly or drops it temporarily while a main shaft 72 rotates one time, since a rotational frequency is detected based on one rotation of a main shaft 72, the exact rotational frequency of a main shaft 72 is undetectable. Therefore, when a command rotational frequency is raised rapidly and the rotational frequency of a main shaft 72 is detected based on a pulse signal while a main shaft 71 rotates one time, there is a problem that exceed a command rotational frequency with the new rotational frequency of a

main shaft 72, and overshoot occurs. When a command rotational frequency is dropped rapidly and the rotational frequency of a main shaft 72 is similarly detected based on a pulse signal while a main shaft 71 rotates one time, there is a problem that it is less than a command rotational frequency with the new rotational frequency of a main shaft 72, and undershooting occurs.

[0009] Made in order that this invention may solve the above-mentioned trouble, the 1st purpose is to offer the revolving-speed-control equipment and the revolving-speed-control approach of the weaving machine to which the rotational frequency of a weaving machine or a motor can be rapidly changed by the time a weaving machine or a motor rotates one time.

[0010] Even if the 2nd purpose changes the engine speed of a weaving machine or a motor rapidly, it is to offer the revolving-speed-control equipment and the revolving-speed-control approach of a weaving machine it can prevent overshoot or undershooting from generating in an engine speed.

[0011]

[Means for Solving the Problem] In order to solve the above-mentioned trouble, invention according to claim 1 By changing the command frequency outputted to said motor in the revolving-speed-control equipment of the weaving machine which operates by the motor The inverter control means which controls the engine speed of this motor and controls the engine speed of a weaving machine, The 1st rotation detection means which outputs a pulse signal whenever said weaving machine or motor rotates one time, 2nd rotation detection means by which only a predetermined number outputs a pulse signal while said weaving machine or motor rotates one time, In the condition that said weaving machine or motor is rotating at the command rotational frequency defined beforehand After asking for the occasional instant rotational frequency of a weaving machine or a motor based on the period of the pulse signal outputted from said 2nd rotation detection means while said weaving machine or motor rotates one time, A field judging means to ask for the maximum and the minimum instant rotational frequency, and to ask for the heavy-loading transitional zone which shifts to the minimum instant rotational frequency from the light load transitional zone and the maximum instant rotational frequency which shift to the maximum instant rotational frequency from the minimum instant rotational frequency, When raising the command engine speed of said weaving machine or a motor, the command frequency outputted to a motor using an inverter control means within the light load transitional zone called for by the field judging means is raised. When you drop the command engine speed of said weaving machine or a motor, let it be the summary to have had a frequency control means to drop the command frequency outputted to a motor using an inverter control means within the heavy-loading transitional zone called for by the field judging means.

[0012] In the revolving-speed-control equipment of the weaving machine to which invention according to claim 2 operates by the motor The inverter control means which controls the engine speed of this motor and controls the engine speed of a weaving machine by changing the command frequency outputted to said motor, The 1st rotation detection means which outputs a pulse signal whenever said weaving machine or motor rotates one time, 2nd rotation detection means by which only a predetermined number outputs a pulse signal while said weaving machine or motor rotates one time, In the condition that said weaving machine or motor is rotating at the command rotational frequency defined beforehand After asking for the occasional instant rotational frequency of a weaving machine or a motor based on the period of the pulse signal outputted from said 2nd rotation detection means while said weaving machine or motor rotates one time, Max and the minimum instant rotational frequency list are asked for the same instant rotational frequency which becomes equal to a command rotational frequency. A field judging means to ask for the heavy-loading field which shifts to the same instant rotational frequency again through the minimum instant rotational frequency from the light load field which shifts to the same instant rotational frequency again through the maximum instant rotational frequency from the same instant rotational frequency, and the same instant rotational frequency, When raising the command engine speed of said weaving machine or a motor, the command frequency outputted to a motor using an inverter control means in the light load field called for by the field judging means is raised. When you drop the command engine speed of said weaving machine or a motor, let it be the summary to have had a frequency control means to drop the command frequency outputted to a motor using an inverter control means in the heavy-loading field called for by the field judging means.

[0013] In the revolving-speed-control equipment of the weaving machine to which invention according to claim 3 operates by the motor The inverter control means which controls the engine speed of this motor and controls the engine speed of a weaving machine by changing the command frequency outputted to said motor, The 1st rotation detection means which outputs a pulse signal whenever said weaving machine or motor rotates one time, 2nd rotation detection means by which only a predetermined number outputs a pulse signal while said

weaving machine or motor rotates one time, In the condition that said weaving machine or motor is rotating at the command rotational frequency defined beforehand After asking for the occasional instant rotational frequency of a weaving machine or a motor based on the period of the pulse signal outputted from said 2nd rotation detection means while said weaving machine or motor rotates one time, A field judging means to ask for the maximum and the minimum instant rotational frequency, and to ask for the heavy-loading transitional zone which shifts to the minimum instant rotational frequency from the light load transitional zone and the maximum instant rotational frequency which shift to the maximum instant rotational frequency from the minimum instant rotational frequency, A transit time operation means to calculate transit time until it shifts to the minimum instant rotational frequency from transit time and the maximum instant rotational frequency until it shifts to the maximum instant rotational frequency from the minimum instant rotational frequency based on the pulse signal from said 2nd rotational frequency detection means, An average rotational frequency operation means to calculate the average rotational frequency of a weaving machine or a motor based on the pulse signal from the 1st rotational frequency detection means, That weaving machine when asking with said average rotational frequency operation means, or the average rotational frequency of a motor, The command frequency from the inverter control means currently then outputted to the motor, A frequency operation means to calculate a new command frequency that it should output to a motor from an inverter control means based on a new command engine speed to newly change, That a command frequency should be changed into a new command frequency based on the new command frequency calculated with said frequency operation means, and the command frequency and transit time which are outputted from the inverter control means When raising the command rotational frequency of a percent-change operation means to calculate the percent change of an inverter output frequency, and a said weaving machine or a motor, When raising the command frequency outputted to a motor using an inverter control means by the percent change called for with the percent-change operation means in the light load transitional zone and dropping the command rotational frequency of said weaving machine or a motor, Let it be the summary to have had a frequency control means to drop the command frequency outputted to a motor using an inverter control means by the percent change called for with the percent-change operation means in the heavy-loading transitional zone.

[0014] In the revolving-speed-control equipment of the weaving machine to which invention according to claim 4 operates by the motor The inverter control means which controls the engine speed of this motor and controls the engine speed of a weaving machine by changing the command frequency outputted to said motor, The 1st rotation detection means which outputs a pulse signal whenever said weaving machine or motor rotates one time, 2nd rotation detection means by which only a predetermined number outputs a pulse signal while said weaving machine or motor rotates one time, In the condition that said weaving machine or motor is rotating at the command rotational frequency defined beforehand After asking for the occasional instant rotational frequency of a weaving machine or a motor based on the period of the pulse signal outputted from said 2nd rotation detection means while said weaving machine or motor rotates one time, Max and the minimum instant rotational frequency list are asked for the same instant rotational frequency which becomes equal to a command rotational frequency. A field judging means to ask for the heavy-loading field which shifts to the same instant rotational frequency again through the minimum instant rotational frequency from the light load field which shifts to the same instant rotational frequency again through the maximum instant rotational frequency from the same instant rotational frequency, and the same instant rotational frequency, Transit time until it shifts to the same instant rotational frequency again through the minimum instant rotational frequency from transit time and the same instant rotational frequency until it shifts to the same instant rotational frequency again through the maximum instant rotational frequency based on the pulse signal outputted from said 2nd rotational frequency detection means from the same instant rotational frequency A transit time operation means to calculate, and an average rotational frequency operation means to calculate the average rotational frequency of a weaving machine or a motor based on the pulse signal from the 1st rotational frequency detection means, That weaving machine when asking with said average rotational frequency operation means, or the average rotational frequency of a motor, The command frequency from the inverter control means currently then outputted to the motor, A frequency operation means to calculate a new command frequency that it should output to a motor from an inverter control means based on a new command engine speed to newly change, That a command frequency should be changed into a new command frequency based on the new command frequency calculated with said frequency operation means, and the command frequency and transit time which are outputted from the inverter control means When raising the command rotational frequency of a percent-change operation means to calculate the percent change of an inverter output frequency, and a said weaving machine or a motor, When

raising the command frequency outputted from a motor using an inverter control means by the percent change called for with the percent-change operation means in a light load field and dropping the command rotational frequency of said weaving machine or a motor, Let it be the summary to have had a frequency control means to drop the command frequency outputted from a motor using an inverter control means by the percent change called for with the percent-change operation means in a heavy-loading field.

[0015] In the revolving-speed-control approach of a weaving machine that invention according to claim 5 operates by the motor Change of the instant rotational frequency of the weaving machine to the command rotational frequency beforehand defined by the load effect of a weaving machine or a motor is detected. The instant rotational frequency of a weaving machine or a motor serves as min until a weaving machine or a motor rotates one time. Within the light load transitional zone until the instant rotational frequency serves as max, raise a command rotational frequency and the average rotational frequency of a weaving machine or a motor is raised. Let it be the summary to drop a command rotational frequency and to have made it drop the average rotational frequency of a weaving machine or a motor in a heavy-loading field until the instant rotational frequency of a weaving machine or a motor serves as max until a weaving machine or a motor rotates one time, and the instant rotational frequency serves as min.

[0016] In the revolving-speed-control approach of a weaving machine that invention according to claim 6 operates by the motor Change of the instant rotational frequency of the weaving machine to the command rotational frequency beforehand defined by the load effect of a weaving machine or a motor is detected. When the instant rotational frequency of a weaving machine or a motor is equal to a command rotational frequency, raise a command rotational frequency from from in the light load field which becomes equal to a command rotational frequency again through the maximum instant rotational frequency until a weaving machine or a motor rotates one time, and the rotational frequency of a weaving machine or a motor is raised. When the instant rotational frequency of a weaving machine or a motor is equal to a command rotational frequency, let it be the summary to drop a command rotational frequency from from in the heavy-loading field which becomes equal to a command rotational frequency again through the minimum instant rotational frequency until a weaving machine or a motor rotates one time, and to have made it drop the rotational frequency of a weaving machine or a motor.

[0017]

[Function] According to invention according to claim 1, to become a command engine speed, an inverter control means controls the engine speed of a motor, and controls the engine speed of a weaving machine. The 1st rotation detection means outputs a pulse signal, whenever a weaving machine or a motor rotates one time. The 2nd rotation detection means outputs a predetermined number of pulse signals, while a weaving machine or a motor rotates one time. A field judging means asks for the occasional instant rotational frequency of a weaving machine or a motor based on the period of the pulse signal from the 2nd rotation detection means while counting the pulse signal outputted from the 2nd rotation detection means on the basis of the pulse signal outputted from the 1st rotation detection means. A field judging means asks for the heavy-loading transitional zone which shifts to the minimum instant rotational frequency from the light load transitional zone and the maximum instant rotational frequency which shift to the maximum instant rotational frequency from the minimum instant rotational frequency, after searching for the part which the maximum and the minimum instant rotational frequency generate based on the number of counts of the pulse signal outputted from the 2nd rotation detection means while a weaving machine or a motor rotates one time.

[0018] By the time a weaving machine or a motor rotates one time, when raising the command rotational frequency of a weaving machine or a motor, a frequency control means judges the light load transitional zone based on the number of counts of the pulse signal outputted from the 2nd rotation detection means, and raises the command frequency outputted to a motor using an inverter control means within the light load transitional zone. And by the time a weaving machine or a motor rotates one time, when dropping the command rotational frequency of a weaving machine or a motor, a frequency control means judges the heavy-loading transitional zone based on the number of counts of the pulse signal outputted from the 2nd rotation detection means, and drops the command frequency outputted to a motor using an inverter control means within the heavy-loading transitional zone.

[0019] Therefore, by the time it becomes the maximum instant rotational frequency from the minimum instant rotational frequency while a weaving machine or a motor rotates one time, the rise of the rotational frequency of a weaving machine or a motor will be performed. Moreover, by the time it becomes the minimum instant rotational frequency from the maximum instant rotational frequency while a weaving machine or a motor

rotates one time, descent of the rotational frequency of a weaving machine or a motor will be performed. Consequently, the rotational frequency of a motor follows and it becomes possible to rise or drop the rotational frequency of a weaving machine or a motor efficiently.

[0020] According to invention according to claim 2, to become a command engine speed, an inverter control means controls the engine speed of a motor, and controls the engine speed of a weaving machine. The 1st rotation detection means outputs a pulse signal, whenever a weaving machine or a motor rotates one time. The 2nd rotation detection means outputs a predetermined number of pulse signals, while a weaving machine or a motor rotates one time. A field judging means asks for the occasional instant rotational frequency of a weaving machine or a motor based on the period of the pulse signal from the 2nd rotation detection means while counting the pulse signal outputted from the 2nd rotation detection means on the basis of the pulse signal outputted from the 1st rotation detection means. After searching for the part used as the same instant rotational frequency which becomes equal to a command rotational frequency at max and the minimum instant rotational frequency list based on the number of counts of the pulse signal outputted from the 2nd rotation detection means while a weaving machine or a motor rotates a field judging means one time, It asks for the heavy-loading field which shifts to the same instant rotational frequency again through the minimum instant rotational frequency from the light load field which shifts to the same instant rotational frequency again through the maximum instant rotational frequency from the same instant rotational frequency, and the same instant rotational frequency.

[0021] By the time a weaving machine or a motor rotates one time, when raising the command rotational frequency of a weaving machine or a motor, a frequency control means judges a light load field based on the number of counts of the pulse signal outputted from the 2nd rotation detection means, and raises the command frequency outputted to a motor using an inverter control means in a light load field. And by the time a weaving machine or a motor rotates one time, when dropping the command rotational frequency of a weaving machine or a motor, a frequency control means judges a heavy-loading field based on the number of counts of the pulse signal outputted from the 2nd rotation detection means, and drops the command frequency outputted to a motor using an inverter control means in a heavy-loading field.

[0022] Therefore, by the time it becomes the same instant rotational frequency from the same instant rotational frequency while a weaving machine or a motor rotates one time again through the maximum instant rotational frequency, the rise of the rotational frequency of a weaving machine or a motor will be performed. By the time it becomes the same instant rotational frequency from the same instant rotational frequency while a weaving machine or a motor rotates one time again through the minimum instant rotational frequency, descent of the rotational frequency of a weaving machine or a motor will be performed. Consequently, the rotational frequency of a motor follows control of an inverter control means, and it becomes possible to rise or drop the rotational frequency of a weaving machine or a motor efficiently.

[0023] According to invention according to claim 3, to become a command engine speed, an inverter control means controls the engine speed of a motor, and controls the engine speed of a weaving machine. The 1st rotation detection means outputs a pulse signal, whenever a weaving machine or a motor rotates one time. The 2nd rotation detection means outputs a predetermined number of pulse signals, while a weaving machine or a motor rotates one time. A field judging means asks for the occasional instant rotational frequency of a weaving machine or a motor based on the period of the pulse signal from the 2nd rotation detection means while counting the pulse signal outputted from the 2nd rotation detection means on the basis of the pulse signal outputted from the 1st rotation detection means. A field judging means asks for the heavy-loading transitional zone which shifts to the minimum instant rotational frequency from the light load transitional zone and the maximum instant rotational frequency which shift to the maximum instant rotational frequency from the minimum instant rotational frequency, after searching for the part which the maximum and the minimum instant rotational frequency generate based on the number of counts of the pulse signal outputted from the 2nd rotation detection means.

[0024] Moreover, a transit time operation means calculates transit time until it shifts to the maximum instant rotational frequency from the minimum instant rotational frequency based on the pulse signal outputted from the 2nd rotation detection means, and transit time until it shifts to the minimum instant rotational frequency from the maximum instant rotational frequency. An average rotational frequency operation means calculates the average rotational frequency of a weaving machine or a motor based on the pulse signal from the 1st rotation detection means. A frequency operation means calculates the weaving machine at that time or the average engine speed of a motor, the command frequency from the inverter control means currently then outputted to

the motor, and the new command frequency outputted to a motor from an inverter control means based on a command engine speed to newly change. A percent-change operation means calculates the percent change of the inverter output frequency for changing a command frequency into a new command frequency into transit time.

[0025] By the time a weaving machine or a motor rotates one time, when raising the command rotational frequency of a weaving machine or a motor, a frequency control means judges the light load transitional zone based on the number of counts of the pulse signal outputted from the 2nd rotation detection means, and raises the command frequency outputted to a motor using an inverter control means in the percent change of an inverter output frequency within the light load transitional zone. And by the time a weaving machine or a motor rotates one time, when dropping the command rotational frequency of a weaving machine or a motor, a frequency control means judges the heavy-loading transitional zone based on the number of counts of the pulse signal outputted from the 2nd rotation detection means, and drops the command frequency outputted to a motor using an inverter control means in the percent change of an inverter output frequency within the heavy-loading transitional zone.

[0026] Therefore, by the time it becomes the maximum instant rotational frequency from the minimum instant rotational frequency while a weaving machine or a motor rotates one time, based on a percent change, a command frequency will be raised and the rise of the rotational frequency of a weaving machine or a motor will be performed. Moreover, by the time it becomes the minimum instant rotational frequency from the maximum instant rotational frequency in a weaving machine while a weaving machine or a motor rotates one time, based on a percent change, a command frequency will be dropped and descent of the rotational frequency of a weaving machine or a motor will be performed. Consequently, the rotational frequency of a motor follows and it becomes possible to rise or drop the rotational frequency of a weaving machine or a motor efficiently.

[0027] According to invention according to claim 4, to become a command engine speed, an inverter control means controls the engine speed of a motor, and controls the engine speed of a weaving machine. The 1st rotation detection means outputs a pulse signal, whenever a weaving machine or a motor rotates one time. The 2nd rotation detection means outputs a predetermined number of pulse signals, while a weaving machine or a motor rotates one time. A field judging means asks for the occasional instant rotational frequency of a weaving machine or a motor based on the period of the pulse signal from the 2nd rotation detection means while counting the pulse signal outputted from the 2nd rotation detection means on the basis of the pulse signal outputted from the 1st rotation detection means. A field judging means asks for the heavy-loading field which shifts to the same instant rotational frequency again through a minimum instant rotational frequency from the light load field which shifts from the same instant rotational frequency to the same instant rotational frequency again through the maximum instant rotational frequency, and the same instant rotational frequency, after searching for the part used as the same instant rotational frequency which becomes equal to a command rotational frequency at max and the minimum instant rotational frequency list based on the number of counts of the pulse signal outputted from the 2nd rotation detection means.

[0028] Moreover, a transit time operation means calculates transit time until it shifts to the same instant rotational frequency again through the minimum instant rotational frequency based on the pulse signal outputted from the 2nd rotation detection means from the same instant rotational frequency, and transit time until it shifts to the same instant rotational frequency again through the maximum instant rotational frequency from the same instant rotational frequency. An average rotational frequency operation means calculates the average rotational frequency of a weaving machine or a motor based on the pulse signal from the 1st rotation detection means. A frequency operation means calculates the weaving machine at that time or the average engine speed of a motor, the command frequency from the inverter control means currently then outputted to the motor, and the new command frequency outputted to a motor from an inverter control means based on a new command engine speed to newly change. A percent-change operation means calculates the percent change of the inverter output frequency for changing a command frequency into a new command frequency into transit time.

[0029] By the time a weaving machine or a motor rotates one time, when raising the command rotational frequency of a weaving machine or a motor, a frequency control means judges a light load field based on the number of counts of the pulse signal outputted from the 2nd rotation detection means, and raises the command frequency outputted to a motor using an inverter control means with the amplification factor of an inverter output frequency in a light load field. And by the time a weaving machine or a motor rotates one time, when dropping the command rotational frequency of a weaving machine or a motor, a frequency control means

judges a heavy-loading field based on the number of counts of the pulse signal outputted from the 2nd rotation detection means, and drops the command frequency outputted to a motor using an inverter control means with the amplification factor of an inverter output frequency in a heavy-loading field.

[0030] Therefore, by the time it becomes the same instant rotational frequency from the same instant rotational frequency while a weaving machine or a motor rotates one time again through the maximum instant rotational frequency, a command frequency will rise based on an amplification factor, and the rise of the rotational frequency of a weaving machine or a motor is performed. By the time it becomes the same instant rotational frequency from the same instant rotational frequency while a weaving machine or a motor rotates one time again through the minimum instant rotational frequency, a command frequency will descend based on an amplification factor, and descent of the rotational frequency of a weaving machine or a motor is performed. Consequently, the rotational frequency of a motor follows control of an inverter control means, and it becomes possible to rise or drop the rotational frequency of a weaving machine or a motor efficiently.

[0031] According to invention according to claim 5, the load effect of a weaving machine detects the instant rotational frequency of the weaving machine to a command rotational frequency, or a motor. Within the light load transitional zone until the instant rotational frequency of a weaving machine or a motor serves as min until a weaving machine or a motor rotates one time, and the instant rotational frequency serves as max, a command rotational frequency is raised and the rotational frequency of a weaving machine or a motor is raised. Within the heavy-loading transitional zone until the instant rotational frequency of a weaving machine or a motor serves as max until a weaving machine or a motor rotates one time, and the instant rotational frequency serves as min, a command rotational frequency is dropped and the rotational frequency of a weaving machine or a motor is dropped.

[0032] According to invention according to claim 6, the load effect of a weaving machine detects the instant rotational frequency of the weaving machine to a command rotational frequency, or a motor. When the instant rotational frequency of a weaving machine or a motor is equal to a command rotational frequency, in a light load field until a weaving machine or a motor rotates one time and it becomes equal again through the maximum instant rotational frequency [from], a command rotational frequency is raised and the rotational frequency of a weaving machine or a motor is raised. When the instant rotational frequency of a weaving machine or a motor is equal to a command rotational frequency, in a heavy-loading field until a weaving machine or a motor rotates one time and it becomes equal to a command rotational frequency again through the minimum instant rotational frequency [from], a command rotational frequency is dropped and the rotational frequency of a weaving machine or a motor is dropped.

[0033]

[Example] Hereafter, one example which materialized this invention is explained based on drawing 1 - drawing 4 . As shown in drawing 1 and drawing 2 , the Maine motor 2 is formed in the weaving machine 1. This Maine motor 2 is connected to the main shaft 3 of a weaving machine 1. By rotating said Maine motor 2, a main shaft 3 can rotate and a weaving machine 1 can be operated now. moreover -- a weaving machine 1 -- a weaving machine -- the control unit 5 is formed. a weaving machine -- the command rotational frequency signal which makes a control unit 5 rotate the rotational frequency of a main shaft 3 at the command rotational frequency rpm 0 defined beforehand is outputted, or the various equipments formed in weaving machines 1 other than main shaft 3 are controlled. in addition, a weaving machine -- a control unit 5 outputs the new command rotational frequency signal which changes the command rotational frequency rpm 0 of a main shaft 3 into the new command rotational frequencies rpm01 and rpm02.

[0034] The encoder 6 as 1st and 2nd rotation detection means is connected to said main shaft 3, and the rotational frequency of the main shaft 3 rotated by the Maine motor 2, i.e., the rotational frequency of a weaving machine 1, is detected. And from an encoder 6, if a main shaft 3 rotates one time, 180 A phase pulse signals SG1 will be outputted. Similarly, from an encoder 6, whenever a main shaft 3 rotates one time, one Z phase pulse signal SG2 is outputted.

[0035] Said Maine motor 2 is connected to revolving-speed-control equipment 7. Revolving-speed-control equipment 7 carries out drive control of the Maine motor 2, and controls the rotational frequency of a main shaft 3. Next, the configuration of revolving-speed-control equipment 7 is explained.

[0036] Waveform shaping circuits 8 and 9 are established in revolving-speed-control equipment 7. Waveform shaping circuits 8 and 9 are connected to the controller 10 as a field judging means, a frequency control means, a transit time operation means, an average rotational frequency operation means, and a percent-change operation means. The A phase and Z phase pulse signals SG1 and SG2 from an encoder 6 are inputted into a

waveform shaping circuit 8, respectively. A waveform shaping circuit 8 changes an A phase and Z phase pulse signals SG1 and SG2, and outputs them to a controller 10. a waveform shaping circuit 9 -- a weaving machine -- the signal of the command rotational frequency rpm 0 of the main shaft 3 outputted from a control unit 5 is inputted. A waveform shaping circuit 9 changes the signal of the command rotational frequency rpm 0, and outputs it to a controller 10.

[0037] Moreover, the inverter control device 11 as an inverter control means is formed in revolving-speed-control equipment 7. The inverter control device 11 consists of a rectifier circuit 13, a smoothing circuit 14, and a switching circuit 15. The three phase power source 12 is connected to a rectifier circuit 13, and AC power supply is changed into DC power supply. The DC power supply changed into the direct current by the rectifier circuit 13 are graduated by the smoothing circuit 14. The DC power supply graduated by the smoothing circuit 14 are outputted to a switching circuit 15.

[0038] The drive circuit 16 which carries out switching control of the switching element which a switching circuit 15 does not illustrate is connected to said controller 10. And a controller 10 carries out switching control of the switching element which a switching circuit 15 does not illustrate through the drive circuit 16, and outputs the three-phase-alternating-current power source used as the command frequency f0 to the Maine motor 2 from a switching circuit 15.

[0039] the weaving machine of a weaving machine 1 -- a control unit 5 -- this -- in order to rotate the main shaft 3 of a weaving machine 1 at the command rotational frequency rpm 0 and to make a weaving machine 1 operate, the command rotational frequency signal corresponding to the command rotational frequency rpm 0 is outputted to a waveform shaping circuit 9. A waveform shaping circuit 9 changes a command rotational frequency signal, and outputs it to a controller 10. A controller 10 calculates the command frequency f0 for rotating a main shaft 3 at the command rotational frequency rpm 0 based on a command rotational frequency signal. A controller 10 carries out switching control of the switching element which the switching circuit 15 in the inverter control device 11 does not illustrate through the drive circuit 16 so that it may become this command frequency f0. Then, the inverter output used as the command frequency f0 is outputted to the Maine motor 2.

[0040] If the Maine motor 2 drives and a main shaft 3 rotates with the inverter output used as the command frequency f0, an encoder 6 will output an A phase and Z phase pulse signals SG1 and SG2 to the waveform shaping circuit 8 of revolving-speed-control equipment 7. A waveform shaping circuit 8 changes the pulse signal of an A phase and Z phase pulse signals SG1 and SG2, and outputs it to a controller 10. Z phase pulse signal time interval tz from 1 pulse signal of Z phase pulse signal SG1 outputted whenever a main shaft 1 rotates one time to the following 1 pulse signal It measures and a controller 10 is this time interval tz. It is based and the average rotational frequency rpm 1 of a main shaft 1 is calculated. Based on (1) type, a controller 10 calculates this average rotational frequency rpm 1.

[0041]

1(rpm) = 60/time interval tz of average rotational frequencies rpm -- (1) Formula tz, for example, Z phase pulse signal time interval from 1 pulse signal of Z phase pulse signal SG1 to the following 1 pulse signal, If a controller 10 measures having been set to 0.1 (s), this controller 10 will calculate the average rotational frequency rpm 1 based on (1) type. In this case, average rotational frequency rpm 1= 600 (rpm) of a main shaft 3 It becomes.

[0042] By the way, it goes for the reed which is not illustrated while the main shaft 3 of a weaving machine 1 rotates one time to drive in the weft which warp let pass from the predetermined location, and a reed performs after that 1 round-trip actuation which returns to a predetermined location. And when a load becomes large by actuation of a reed, the load torque concerning the Maine motor 2 becomes large. Then, the slippage of the Maine motor 2 increases and the instant rotational frequency rpm 2 decreases. Moreover, when a load turns into a minus load small by actuation of a reed, the load torque concerning the Maine motor 2 becomes small. Then, the slippage of the Maine motor 2 decreases and the instant rotational frequency rpm 2 increases. Therefore, when a main shaft 3 rotates one time by actuation of a reed etc., the occasional instant rotational frequency rpm 2 of this main shaft 3 will change. Moreover, the fluctuation property of the occasional rotational frequency of a main shaft 3 is periodic change.

[0043] A controller 10 will start the count of the A phase pulse signal SG2 by which resets the count of the A phase pulse signal SG2, and a sequential input is carried out after that, if Z phase pulse signal SG1 is inputted. And if the following Z phase pulse signal SG1 is inputted, a count will be reset again and the same count as the above will be performed. Moreover, a controller 10 is the A phase pulse signal time interval tA of one period of

180 A phase pulse signals SG2, while Z phase pulse signal SG1 is inputted and the following Z phase pulse signal SG1 is inputted (i.e., while a main shaft 1 rotates one time). It measures. A controller 10 is the A phase pulse signal time interval tA. It is based and the occasional instant rotational frequency rpm 2 of a main shaft 3 is calculated. Based on (2) types, a controller 10 calculates this instant average rotational frequency rpm 2.
[0044]
2(rpm) = 60/time-interval tA x180 of instant rotational frequencies rpm --(2) type 180: The number tA of the A phase pulse signals SG2 outputted when a main shaft 3 rotates one time, for example, the A phase pulse signal time interval of one period of the A phase pulse signal SG2, If a controller 10 measures having been set to 0.5 (ms), this controller 10 will calculate the instant rotational frequency rpm 2 based on (2) types. In this case, the instant rotational frequency rpm 2 of a main shaft 3 = about 667 (rpm) It becomes.
[0045] A controller 10 asks for the same instant rotational frequency Hrpm2 to which the maximum instant rotational frequency MAXrpm2 from which the instant rotational frequency rpm 2 serves as max most, the minimum instant rotational frequency MINrpm2 from which the instant rotational frequency rpm 2 serves as min most and the instant rotational frequency rpm 2, and the command rotational frequency rpm 0 become equal, after calculating the instant rotational frequency rpm 2 of the occasional main shaft 3 while a main shaft 3 rotates one time. Furthermore, a controller 10 detects the location (part) where a main shaft 3 serves as the maximum instant rotational frequency MAXrpm2, the minimum instant rotational frequency MINrpm2, and the same instant rotational frequency Hrpm2 based on the count of the A phase pulse signal SG1, after Z phase pulse signal SG2 is inputted.
[0046] Here, the number of counts of the A phase pulse signal SG1 when becoming the maximum instant rotational frequency MAXrpm2 is set to N1, the number of counts of the A phase pulse signal SG1 when becoming the same instant rotational frequency Hrpm2 is set to N2, and the number of counts of the A phase pulse signal SG1 when becoming the minimum instant rotational frequency MINrpm2 is further set to N3. That is, if the instant rotational frequency rpm 2 of a main shaft 3 will turn into the maximum instant rotational frequency MAXrpm2 if the number of counts of the A phase pulse signal SG1 is set to N1, and the number of counts of the A phase pulse signal SG1 is set to N2, the instant rotational frequency rpm 2 of a main shaft 3 will turn into the same instant rotational frequency Hrpm2, and further, if the number of counts of the A phase pulse signal SG1 is set to N3, the instant rotational frequency rpm 2 of a main shaft 3 will turn into the minimum instant rotational frequency MINrpm2.
[0047] And a controller 10 judges the field which the load torque from the maximum instant rotational frequency MAXrpm2 to the minimum instant rotational frequency MINrpm2 increases (greatly) to be the heavy-loading transitional zone HG, and judges the field where the load torque from the minimum instant rotational frequency MINrpm2 to the maximum instant rotational frequency MAXrpm2 decreases (small) to be the light load transitional zone RG.
[0048] Moreover, in the heavy-loading transitional zone HG, a controller 10 calculates the 1st heavy-loading transit time th1 until it becomes the same instant rotational frequency Hrpm2 from the maximum instant rotational frequency MAXrpm2 based on the A phase pulse signal SG1, and the 2nd heavy-loading transit time th2 until it becomes the minimum instant rotational frequency MINrpm2 from the same instant rotational frequency Hrpm2. Similarly, in the light load transitional zone RG, a controller 10 calculates the 1st light load transit time tr1 until it becomes the same instant rotational frequency Hrpm2 from the minimum instant rotational frequency MINrpm2 based on the A phase pulse signal SG1, and the 2nd light load transit time tr2 until it becomes the maximum instant rotational frequency MAXrpm2 from the same instant rotational frequency Hrpm2.
[0049] the weaving machine of a weaving machine 1 -- if the command rotational frequency rpm 0 outputted from a control unit 5 rises and it becomes the new command rotational frequency rpm 01, a controller 10 will compare the command rotational frequency rpm 0 with the new command rotational frequency rpm 01, and will calculate the increment. A controller 10 makes this increment increase within the light load transitional zone RG. Setting to this example, a controller 10 makes the command rotational frequency rpm 0 the new command rotational frequency rpm 01 between the same instant rotational frequency Hrpm2 and the maximum instant rotational frequency MAXrpm2 in the light load transitional zone RG.
[0050] At this time, a controller 10 calculates the new command frequency f1 based on (3) types based on the command rotational frequency rpm 0, the command frequency f0, and the new command rotational frequency rpmp01.
[0051]

(3) new -- command frequency f1=f0xrpm01/rpm0 -- a formula, next a controller 10 deduct the command frequency f0 from the new command frequency f1 called for by (3) formulas, break the increment by the 2nd light load transit time tr2, and calculate the rate of increase alpha of the frequency per unit time amount for changing into the new command frequency f1.

[0052] And a controller 10 judges the field of the same instant rotational frequency Hrpm2 in the light load transitional zone RG to the maximum instant rotational frequency MAXrpm2 based on the A phase pulse signal SG1. In this example, since the location used as the generating point of Z phase pulse signal SG2 and the same instant rotational frequency Hrpm2 in the light load transitional zone RG is the same, when an A phase and Z phase pulse signals SG1 and SG2 are inputted into a controller 10 at coincidence, it is judged that this controller 10 became the same instant rotational frequency Hrpm2 in the light load transitional zone RG. Then, a controller 10 performs switching control of a switching circuit 15 through the drive circuit 16, and changes the command frequency f0 into the new command frequency f1. That is, a controller 10 increases the command frequency f0 based on the rate of increase alpha per unit time amount, and when it goes through the 2nd light load transit time tr2, it carries out switching control of the switching circuit 15 through the drive circuit 16 so that it may become the new command frequency f1.

[0053] on the contrary, the weaving machine of a weaving machine 1 -- if the command rotational frequency rpm 0 outputted from a control unit 5 descends and it becomes the new command rotational frequency rpm 02, a controller 10 will compare the command rotational frequency rpm 0 with the new command rotational frequency rpm 02, and will calculate the decrement. A controller 10 decreases this decrement within the heavy-loading transitional zone HG. Setting to this example, a controller 10 makes the command rotational frequency rpm 0 the new command rotational frequency rpm 02 between the same instant rotational frequency Hrpm2 and the minimum instant rotational frequency MINrpm2 in the heavy-loading transitional zone HG.

[0054] At this time, a controller 10 calculates the new command frequency f2 based on (4) types based on the command rotational frequency rpm 0, the command frequency f0, and the new command rotational frequency rpmp02.

[0055]

(4) new -- command frequency f2=f0xrpm02/rpm0 -- a formula, next a controller 10 deduct the new command frequency f2 called for by (4) formulas from the command frequency f0, break the decrement by the 2nd heavy-loading transit time th2, and calculate the percentage reduction beta of the frequency per unit time amount for changing into the new command frequency f2.

[0056] And a controller 10 judges the field of the minimum instant rotational frequency MINrpm2 based on the A phase pulse signal SG1 from the same instantaneous frequency Hrpm2 in the heavy-loading transitional zone HG. In this case, if Z phase pulse signal SG2 is inputted into a controller 10, a controller 10 will start the count of the A phase pulse signal SG1. And when the number of counts of the A phase pulse signal SG1 is set to N2, it judges with a controller 10 being the same instantaneous frequency Hrpm2 in the heavy-loading transitional zone HG. Then, a controller 10 performs switching control of a switching circuit 15 through the drive circuit 16, and changes the command frequency f0 into the new command frequency f2. That is, when it decreases based on the percentage reduction beta per unit time amount and goes through the 2nd heavy-loading transit time th2 in the command frequency f0, a controller 10 carries out switching control of the switching circuit 15 through the drive circuit 16 so that it may become the new command frequency f2.

[0057] Moreover, a controller 10 changes the new command frequencies f1 and f2 until the following pulse signal SG2 is inputted from the first Z phase pulse signal SG2 inputted into a controller 10, after changing into the new command frequencies f1 and f2. And Z phase pulse signal time interval tz of the first Z phase pulse signal SG2 inputted into a controller 10 after changing into the new command frequencies f1 and f2, and the following pulse signal SG2 It is based and the average rotational frequency rpm 1 of a main shaft 3 is calculated.

[0058] And a controller 10 judges whether the average rotational frequency rpm 1 and the new command rotational frequencies rpm01 and rpm02 become equal, and when equal, it fixes the command frequencies f1 and f2. Moreover, when the average rotational frequency rpm 1 is not equal to the new command rotational frequencies rpm01 and rpm02, a controller 10 changes the command frequencies f1 and f2, and as it makes equal the average rotational frequency rpm 1 and the new command rotational frequencies rpm01 and rpm02, it carries out feedback control.

[0059] Next, an operation of the revolving-speed-control equipment 7 of the weaving machine constituted as mentioned above is explained. a weaving machine 1 is operated -- it should make -- a weaving machine -- a

control unit 5 outputs the command rotational frequency signal corresponding to the command rotational frequency rpm 0 defined beforehand to a waveform shaping circuit 9. A waveform shaping circuit 9 changes a command rotational frequency signal, and outputs it to a controller 10. A controller 10 calculates the command frequency f0 based on a command rotational frequency signal. A controller 10 carries out switching control of the switching element which this switching circuit 15 does not illustrate through the drive circuit 16 so that the inverter output used as the command frequency f0 may be outputted from a switching circuit 15.

[0060] It is outputted to the Maine motor 2, this Maine motor 2 operates, and a main shaft 3 rotates the inverter output used as the command frequency f0. An encoder 6 detects rotation of a main shaft 3. Moreover, an encoder 6 outputs Z phase pulse signal SG2 to a waveform shaping circuit 8, whenever a main shaft 3 rotates one time. Similarly, an encoder 6 outputs 180 A phase pulse signals SG1 to a waveform shaping circuit 8 at equal spacing, while a main shaft 3 rotates one time. A waveform shaping circuit 8 changes an A phase and Z phase pulse signals SG1 and SG2, and outputs them to a controller 10. And a controller 10 is Z phase pulse signal time interval tz of Z phase pulse SG1. While measuring, it is this Z phase pulse signal time interval tz. And the average rotational frequency rpm 1 is calculated based on (1) type.

[0061] It compares whether a controller 10 has the average rotational frequency rpm 1 and the equal command rotational frequency rpm 0. When the average engine speed rpm 1 and the command engine speed rpm 0 are equal, a controller 10 fixes the timing which performs switching control of the switching element in a switching circuit 15, and fixes the command frequency f0. Moreover, when the average engine speed rpm 1 and the command engine speed rpm 0 are not equal, a controller 10 changes the timing which performs switching control of the switching element in a switching circuit 15, and it carries out feedback control so that the average engine speed rpm 1 and the command engine speed rpm 0 may become equal.

[0062] Moreover, as shown in drawing 2 , a controller 10 calculates the occasional instant rotational frequency rpm 2 of this main shaft 3 based on one period of the A phase pulse signal SG1, and (2) types, while a main shaft 3 rotates one time. On the other hand, a controller 10 carries out the sequential count of the number of the A phase pulse signals SG1, after resetting a counter at the same time Z phase pulse signal SG2 is inputted. And a controller 10 asks for the maximum instant rotational frequency MAXrpm2 of a main shaft 3, the same instant rotational frequency Hrpm2 which becomes equal to the command rotational frequency rpm 0, and the minimum instant rotational frequency MINrpm2. And a controller 10 detects the number of counts of the A phase pulse signal SG2 when becoming the number of counts of the A phase pulse signal SG2 when becoming the number of counts of the A phase pulse signal SG2 when becoming the maximum instant rotational frequency MAXrpm2, and the same instant rotational frequency Hrpm2, and the minimum instant rotational frequency MINrpm2.

[0063] In the case of this example, if the instant rotational frequency rpm 2 of a main shaft 3 will turn into the maximum instant rotational frequency MAXrpm2 if the number of counts of the A phase pulse signal SG1 is set to N1, and the number of counts of the A phase pulse signal SG1 is set to N2, the instant rotational frequency rpm 2 of a main shaft 3 will turn into the same instant rotational frequency Hrpm2. Furthermore, if the number of counts of the A phase pulse signal SG1 is set to N3, the instant rotational frequency rpm 2 of a main shaft 3 will turn into the minimum instant rotational frequency MINrpm2.

[0064] And a controller 10 judges the field which the load torque from the maximum instant rotational frequency MAXrpm2 to the minimum instant rotational frequency MINrpm2 increases to be the heavy-loading transitional zone HG, and judges the field where the load torque from the minimum instant rotational frequency MINrpm2 to the maximum instant rotational frequency MAXrpm2 decreases to be the light load transitional zone RG.

[0065] Moreover, in the heavy-loading transitional zone HG, a controller 10 calculates the 1st heavy-loading transit time th1 until it becomes the same instant rotational frequency Hrpm2 from the maximum instant rotational frequency MAXrpm2 based on the A phase pulse signal SG1, and the 2nd heavy-loading transit time th2 until it becomes the minimum instant rotational frequency MINrpm2 from the same instant rotational frequency Hrpm2. Similarly, in the light load transitional zone RG, a controller 10 calculates the 1st light load transit time tr1 until it becomes the same instant rotational frequency Hrpm2 from the minimum instant rotational frequency MINrpm2 based on the A phase pulse signal SG1, and the 2nd light load transit time tr2 until it becomes the maximum instant rotational frequency MAXrpm2 from the same instant rotational frequency Hrpm2.

[0066] the above processings are performed by the controller 10 in an instant, and it is shown in drawing 3 in the condition that the average rotational frequency rpm 1 of a main shaft 3 is equal to the command rotational

frequency rpm 0 -- as -- time amount t1 -- setting -- a weaving machine -- suppose that the new command rotational frequency signal corresponding to the new command rotational frequency rpm 01 higher than the command rotational frequency rpm 0 was outputted to the controller 10 through the waveform shaping circuit 9 from the control unit 5. Then, a controller 10 compares the command rotational frequency rpm 0 with the new command rotational frequency rpm 01, and calculates the increment. A controller 10 makes the command rotational frequency rpm 0 the new command rotational frequency rpm 01 between the same instant [increment / this] rotational frequency Hrpm2 in the light load transitional zone RG, and the maximum instant rotational frequency MAXrpm2. Therefore, a controller 10 calculates the new command frequency f1 based on (3) types based on the command rotational frequency rpm 0, the command frequency f0, and the new command rotational frequency rpmp01.

[0067] Next, a controller 10 deducts the command frequency f0 from the new command frequency f1 called for by (3) formulas, breaks the increment by the 2nd light load transit time tr2, and calculates the rate of increase alpha of the frequency per unit time amount for changing into the new command frequency f1. And it judges with the controller 10 having become the same instantaneous frequency [in / in this controller 10 / the light load transitional zone RG] Hrpm2, when an A phase and Z phase pulse signals SG1 and SG2 were inputted into a controller 10 at coincidence. Then, a controller 10 increases the command frequency f0 based on the rate of increase alpha per unit time amount, and when it goes through the 2nd light load transit time tr2, it carries out switching control of the switching circuit 15 through the drive circuit 16 so that it may become the new command frequency f1.

[0068] Moreover, a controller 10 does not change the new command frequency f1 until the following pulse signal SG2 is inputted from the first Z phase pulse signal SG2 inputted into a controller 10, after changing into the new command frequency f1. And Z phase pulse signal time interval tz of the first Z phase pulse signal SG2 inputted into a controller 10 after changing into the new command frequency f1, and the following pulse signal SG2 Based on (1) type, the average rotational frequency rpm 1 of a main shaft 3 is calculated.

[0069] And a controller 10 judges whether the average rotational frequency rpm 1 and the new command rotational frequency rpm 01 become equal, and when equal, it fixes the new command frequency f1. Moreover, when the average rotational frequency rpm 1 is not equal to the new command rotational frequency rpm 01, a controller 10 changes the new command frequency f1, and as it makes equal the average rotational frequency rpm 1 and the new command rotational frequency rpm 01, it carries out feedback control.

[0070] moreover, it is shown in drawing 4 in the condition that the average rotational frequency rpm 1 of a main shaft 3 is equal to the command rotational frequency rpm 0 -- as -- time amount t2 -- setting -- a weaving machine -- suppose that the new command rotational frequency signal corresponding to the new command rotational frequency rpm 02 lower than the command rotational frequency rpm 0 was outputted to the controller 10 through the waveform shaping circuit 9 from the control unit 5. Then, a controller 10 compares the command rotational frequency rpm 0 with the new command rotational frequency rpm 02, and calculates the decrement. A controller 10 makes the command rotational frequency rpm 0 the new command rotational frequency rpm 02 between the same instant [decrement / this] rotational frequency Hrpm2 in the heavy-loading transitional zone HG, and the maximum instant rotational frequency MINrpm2. Therefore, a controller 10 calculates the new command frequency f2 based on (4) types based on the command rotational frequency rpm 0, the command frequency f0, and the new command rotational frequency rpmp02.

[0071] Next, a controller 10 deducts the command frequency f0 from the new command frequency f2 called for by (4) formulas, breaks the decrement by the 2nd heavy-loading transit time th2, and calculates the percentage reduction beta of the frequency per unit time amount for changing into the new command frequency f2. And a controller 10 judges with this controller 10 having become the same instantaneous frequency Hrpm2 in the heavy-loading transitional zone HG, when an A phase and Z phase pulse signals SG1 and SG2 are inputted into a controller 10 and the number of counts of an A phase pulse signal is set to N2. Then, when it decreases based on the percentage reduction beta per unit time amount and goes through the 2nd heavy-loading transit time th2 in the command frequency f0, a controller 10 carries out switching control of the switching circuit 15 through the drive circuit 16 so that it may become the new command frequency f2.

[0072] Moreover, a controller 10 does not change the new command frequency f2 until the following pulse signal SG2 is inputted from the first Z phase pulse signal SG2 inputted into a controller 10, after changing into the new command frequency f2. And Z phase pulse signal time interval tz of the first Z phase pulse signal SG2 inputted into a controller 10 after changing into the new command frequency f2, and the following pulse signal SG2 Based on (1) type, the average rotational frequency rpm 1 of a main shaft 3 is calculated.

[0073] And a controller 10 judges whether the average rotational frequency rpm 1 and the new command rotational frequency rpm 02 become equal, and when equal, it fixes the new command frequency f2. Moreover, when the average rotational frequency rpm 1 is not equal to the new command rotational frequency rpm 02, a controller 10 changes the new command frequency f2, and as it makes equal the average rotational frequency rpm 1 and the new command rotational frequency rpm 02, it carries out feedback control.
[0074] Therefore, the average rotational frequency rpm 1 of a main shaft 3 is raised to the new command rotational frequency rpm 01 by the light load transitional zone RG while a main shaft 3 rotates one time. Consequently, since the load torque concerning a main shaft 3 is a time of decreasing gradually, even if it raises the command frequency f0 toward the new command frequency fl by the switching circuit 15, the rotational frequency of the Maine motor 2 rises smoothly, and can make the average rotational frequency rpm 1 of a main shaft 3 equal to the new command rotational frequency rpm 01.
[0075] Moreover, the average rotational frequency rpm 1 of a main shaft 3 is dropped to the new command rotational frequency rpm 02 by the heavy-loading transitional zone HG while a main shaft 3 rotates one time. Consequently, since the load torque concerning a main shaft 3 is a time of increasing gradually, even if it drops the command frequency f0 toward the new command frequency f2 by the switching circuit 15, the rotational frequency of the Maine motor 2 can descend smoothly, and can make the average rotational frequency rpm 1 of a main shaft 3 equal to the new command rotational frequency rpm 02.
[0076] Consequently, while a main shaft 1 rotates one time, the average rotational frequency rpm 1 equal to the command rotational frequency rpm 0 of a main shaft 3 can be made into the average rotational frequency rpm 1 equal to the new command rotational frequency rpm 01. Similarly, while a main shaft 1 rotates one time, the average rotational frequency rpm 1 equal to the command rotational frequency rpm 0 of a main shaft 3 can be made into the average rotational frequency rpm 1 equal to the new command rotational frequency rpm 02.
[0077] Furthermore, even if it changes the command frequency f0 rapidly, rotation of the Maine motor 2 is followed. Consequently, an overcurrent can flow to the switching element of a switching circuit 15, this switching circuit 15 can perform protected operation, and it can prevent stopping the Maine motor 2.
[0078] Moreover, it was made to raise the rotational frequency of a main shaft 3 in this example between the same instant rotational frequency Hrpm2 in the light load transitional zone RG, and the maximum instant rotational frequency MAXrpm2. That is, when load torque became [the instant rotational frequency rpm 2 of a main shaft 3] larger than the command rotational frequency rpm 0 small, it was made to raise the rotational frequency of a main shaft 3. Consequently, the rotational frequency of a main shaft 3 can be raised smoothly and efficiently, and can be made to change.
[0079] It was made similarly to raise the rotational frequency of a main shaft 3 in this example between the same instant rotational frequency Hrpm2 in the heavy-loading transitional zone HG, and the minimum instant rotational frequency MINrpm2. That is, when load torque became [the instant rotational frequency rpm 2 of a main shaft 3] smaller than the command rotational frequency rpm 0 greatly, it was made to drop the rotational frequency of a main shaft 3. Consequently, the rotational frequency of a main shaft 3 can be dropped smoothly and efficiently, and can be made to change.
[0080] Moreover, it asks for the field suitable for rising or dropping the rotational frequency of a main shaft 3 based on the A phase pulse signal SG1, and it was based on the percent changes alpha and beta per unit time amount in the field, and the rotational frequency of a main shaft 3 was risen or dropped. That is, in case the rotational frequency of a main shaft 3 is changed, Z phase pulse signal SG2 is not used, but it is carrying out based on the A phase pulse signal SG1. And after a rise or descent of the rotational frequency of a main shaft 3 is performed and being stabilized, it is made to control the rotational frequency of a main shaft 3 by Z phase pulse signal SG2. Consequently, when rising or dropping the engine speed of a main shaft 3, it can avoid making the engine speed of this main shaft 3 generate overshoot and undershooting.
[0081] In this example, although shape was taken to the roll control equipment 7 which controls the rotational frequency of the main shaft 3 of a weaving machine 1, it is good also as revolving-speed-control equipment 7 which controls the rotational frequency of the Maine motor 2 and controls operation of a weaving machine 1.
[0082] It was made to raise the rotational frequency of a main shaft 3 in this example between the same instant rotational frequency Hrpm2 in the light load transitional zone RG, and the maximum instant rotational frequency MAXrpm2. In addition, you may make it raise the rotational frequency of a main shaft 3 by whole light load transitional-zone RG. Furthermore, it is also possible to set up the field of the arbitration of the light load transitional zone RG, and to make it raise the rotational frequency of a main shaft 3 in the field.
[0083] It was made similarly to drop the rotational frequency of a main shaft 3 between the same instant

rotational frequency Hrpm2 in the heavy-loading transitional zone HG, and the minimum instant rotational frequency MINrpm2. In addition, you may make it drop the rotational frequency of a main shaft 3 by the whole heavy-loading transitional-zone HG. Furthermore, it is also possible to set up the field of the arbitration of the heavy-loading transitional zone HG, and to make it raise the rotational frequency of a main shaft 3 in the field.
[0084] Moreover, it set to this example and changed into the rotational frequency which serves as a target at once in the field suitable for rising or dropping the rotational frequency of a main shaft 3. In addition, you may make it raise gradually the rotational frequency which serves as a target in the field suitable for rising or dropping the rotational frequency of a main shaft 3. for example, when the rotational frequency which the rotational frequency of a main shaft 3 serves as 600rpm, and serves as a target sets to 700rpm, listen in the field suitable for raising the rotational frequency of a main shaft 3 -- ** 650rpm is raised. Next, 700rpm is raised in the field suitable for raising the rotational frequency of a main shaft 3. In this case, this may be divided into two or more more steps although the rotational frequency of 600rpm is set to 700rpm in two steps. on the contrary, when the rotational frequency from which the rotational frequency of a main shaft 3 serves as a target by 600rpm is 500rpm, listen in the field suitable for dropping the rotational frequency of a main shaft 3 -- ** 550rpm may be raised and you may make it descend to 500rpm in the field suitable for dropping the rotational frequency of the following main shaft 3
[0085] Next, although example of another of this invention is explained, since the configuration of a weaving machine 1 and revolving-speed-control equipment 7 is the same as that of drawing 1 , explanation is omitted. In this example of another, as shown in drawing 5 , while a main shaft 3 rotates one time, a controller 10 detects the same instant rotational frequency Hrpm2 in case the same instant rotational frequency Hrpm2 and load torque in case load torque decreases based on the A phase pulse signal SG1 increase, and makes a field in the meantime the light load field RA. Moreover, a controller 10 is based on the A phase pulse signal SG1, and calculates the light load field transit time tr3 of the field in the light load field RA (until a rotational frequency decreases from the maximum instant rotational frequency MAXrpm2 and it becomes the same instant rotational frequency Hrpm2 in this example) appointed beforehand.
[0086] As shown in drawing 6 , while similarly a main shaft 3 rotates one time, a controller 10 detects the same instant rotational frequency Hrpm2 in case the same instant rotational frequency Hrpm2 and load torque in case load torque increases based on the A phase pulse signal SG1 decrease, and makes a field in the meantime the heavy-loading field HA. Moreover, a controller 10 is based on the A phase pulse signal SG1, and calculates the heavy-loading field transit time tr4 of the field in the heavy-loading field HA (until a rotational frequency increases from the minimum instant rotational frequency MINrpm2 and it becomes the same instant rotational frequency Hrpm2 in this example) appointed beforehand.
[0087] And as shown in drawing 5 , suppose that there were directions which serve as the new command rotational frequency rpm 01 by time amount t1 in the condition that the average rotational frequency rpm 1 of a main shaft 3 is the command rotational frequency rpm 0. Then, a controller 10 deducts the command frequency f0 from the new command frequency f1, breaks the increment by the light load field transit time tr3, and calculates the rate of increase alpha of the frequency for changing into the new command frequency f1 while it calculates the new command frequency f1 corresponding to the new command rotational frequency rpm 01 based on (3) types.
[0088] And a controller 10 judges the light load field RA based on the A phase pulse signal SG1, makes the command frequency f0 increase based on the rate of increase alpha in the field, is made into the new command frequency f1, and raises the average rotational frequency rpm 1 of a main shaft 3 by making the command rotational frequency rpm 0 into the new command rotational frequency rpm 01.
[0089] In this case, the rise of the rotational frequency of a main shaft 3 is made to start from the field where the load torque of a main shaft 3 decreases, and the rotational frequency is changed in the range also including the field which the load torque of a main shaft 3 increases. However, also in the field which load torque increases, the increments in the load torque of a main shaft 3 are still few, and, moreover, the instant rotational frequency Hrpm2 of a main shaft 3 is in a condition higher than the command rotational frequency rpm 0. Consequently, even if it goes up in the new command frequency f1, the Maine motor 2 can follow and drive the command frequency f0 to that rise, and the rotational frequency of a main shaft 3 can be smoothly raised to the new command rotational frequency rpm 01.
[0090] On the contrary, as shown in drawing 6 , suppose that there were directions which serve as the new command rotational frequency rpm 02 by time amount t2 in the condition that the average rotational frequency rpm 1 of a main shaft 3 is the command rotational frequency rpm 0. Then, a controller 10 deducts the new

command frequency f2 called for by (4) formulas from the command frequency f0, breaks the decrement by the heavy-loading field transit time tr4, and calculates the decrement beta of the frequency for changing into the new command frequency f2 while it calculates the new command frequency f2 corresponding to the new command rotational frequency rpm 02 based on (4) types.

[0091] And a controller 10 judges the heavy-loading field HA based on the A phase pulse signal SG1, decreases the command frequency f0 based on percentage reduction beta in the field, makes it the new command frequency f2, and drops the average rotational frequency rpm 1 of a main shaft 3 by making the command rotational frequency rpm 0 into the new command rotational frequency rpm 02.

[0092] In this case, descent of the rotational frequency of a main shaft 3 is made to start from the field which the load torque of a main shaft 3 increases, and the rotational frequency is changed in the range also including the field where the load torque of a main shaft 3 decreases. However, also in the field to which load torque decreases, reduction of the load torque of a main shaft 3 is still slight, and, moreover, the instant rotational frequency rpm 2 of a main shaft 3 is in a condition lower than the command rotational frequency rpm 0. Consequently, even if it descends to the new command frequency f2, the Maine motor 2 can follow that descent and can drive the command frequency f0, and the rotational frequency of a main shaft 3 can be smoothly raised to the new command rotational frequency rpm 02.

[0093] Although the rotational frequency of a main shaft 3 was raised in the light load field RA, the field of the arbitration in this field is set up and you may make it raise the rotational frequency of a main shaft 3 in the field of that arbitration in this example of another. Although the rotational frequency of a main shaft 3 was dropped in the heavy-loading field HA, the field of the arbitration in this field is set up and you may make it drop the rotational frequency of a main shaft 3 in the field of that arbitration similarly.

[0094] In this example, although the encoder 6 with which 180 A phase pulse signals SG1 are outputted was used while the main shaft 3 rotated one time, the number of these A phase pulse signals SG1 may be changed if needed.

[0095] Moreover, in this example, the maximum instant rotational frequency MAXrpm2, the minimum instant rotational frequency MINrpm2, the same instant rotational frequency Hrpm2, the heavy-loading transitional zone HG, the light load transitional zone RG, the heavy-loading field HA, and the light load field RA were detected or judged based on the number of counts of the A phase pulse signal SG1. In addition, when a main shaft 3 rotates how many times on the basis of Z phase pulse signal SG2 by the number of counts of the A phase pulse signal SG1, it detects whether the maximum instant rotational frequency MAXrpm2, the minimum instant rotational frequency MINrpm2, and the same instant rotational frequency Hrpm2 occur, and you may make it judge the heavy-loading transitional zone HG, the light load transitional zone RG, the heavy-loading field HA, and the light load field RA based on an include angle.

[0096]

[Effect of the Invention] Since the command frequency which judges the light load transitional zone until a weaving machine or a motor rotates one time, and the heavy-loading transitional zone, and is outputted to a motor from an inverter control means within the light load transitional zone is rapidly raised according to invention according to claim 1 as explained in full detail above, the rotational frequency of a weaving machine or a motor can be raised smoothly, and can be made to follow. Moreover, since the command frequency outputted to a motor from an inverter control means within the heavy-loading transitional zone is dropped rapidly, the rotational frequency of a weaving machine or a motor can be dropped smoothly, and it can be made to follow.

[0097] Since the command frequency which judges a light load field until a weaving machine or a motor rotates one time, and a heavy-loading field and by which a load is outputted to a motor from an inverter control means in a small light load field is raised rapidly according to invention according to claim 2, the rotational frequency of a weaving machine or a motor can be raised smoothly, and can be made to follow. Moreover, since the command frequency by which a load is outputted to a motor from an inverter control means in a large heavy-loading field is dropped rapidly, the rotational frequency of a weaving machine or a motor can be dropped smoothly, and it can be made to follow.

[0098] Since the command frequency outputted to a motor from an inverter control means in the percent change which judged the light load transitional zone until a weaving machine or a motor rotates one time, and the heavy-loading transitional zone, and was called for by the percent-change operation means within the light load transitional zone is raised rapidly according to invention according to claim 3, the number of rotations of a weaving machine or a motor is raised smoothly, and it can avoid generating overshoot. Moreover, since the

command frequency outputted to a motor from an inverter control means in the percent change called for by the percent-change operation means within the heavy-loading transitional zone is dropped rapidly, the rotational frequency of a weaving machine or a motor is dropped smoothly, and it generates undershooting, and can avoid being.

[0099] Since the command frequency outputted to a motor from an inverter control means in the percent change which the light load field until a weaving machine or a motor rotates one time, and the heavy-loading field were judged, and was asked for the load by the percent-change operation means in the small light load field is raised rapidly according to invention according to claim 4, the number of rotations of a weaving machine or a motor is raised smoothly, and it can avoid generating overshoot. Moreover, since the command frequency outputted to a motor from an inverter control means in the percent change asked for the load by the percent-change operation means in the large heavy-loading field is dropped rapidly, the rotational frequency of a weaving machine or a motor is dropped smoothly, and it can avoid generating undershooting.

[0100] According to invention according to claim 5, since a command rotational frequency is rapidly raised within the light load transitional zone until a weaving machine or a motor rotates one time, the rotational frequency of a weaving machine or a motor can be raised smoothly. Moreover, since a command rotational frequency is rapidly dropped within the heavy-loading transitional zone until a weaving machine or a motor rotates one time, the rotational frequency of a weaving machine or a motor can be dropped smoothly.

[0101] According to invention according to claim 6, since a command rotational frequency is rapidly raised in a light load field until a weaving machine or a motor rotates one time, the rotational frequency of a weaving machine or a motor can be raised smoothly. Moreover, since a command rotational frequency is rapidly dropped in a heavy-loading field until a weaving machine or a motor rotates one time, the rotational frequency of a weaving machine or a motor can be dropped smoothly.